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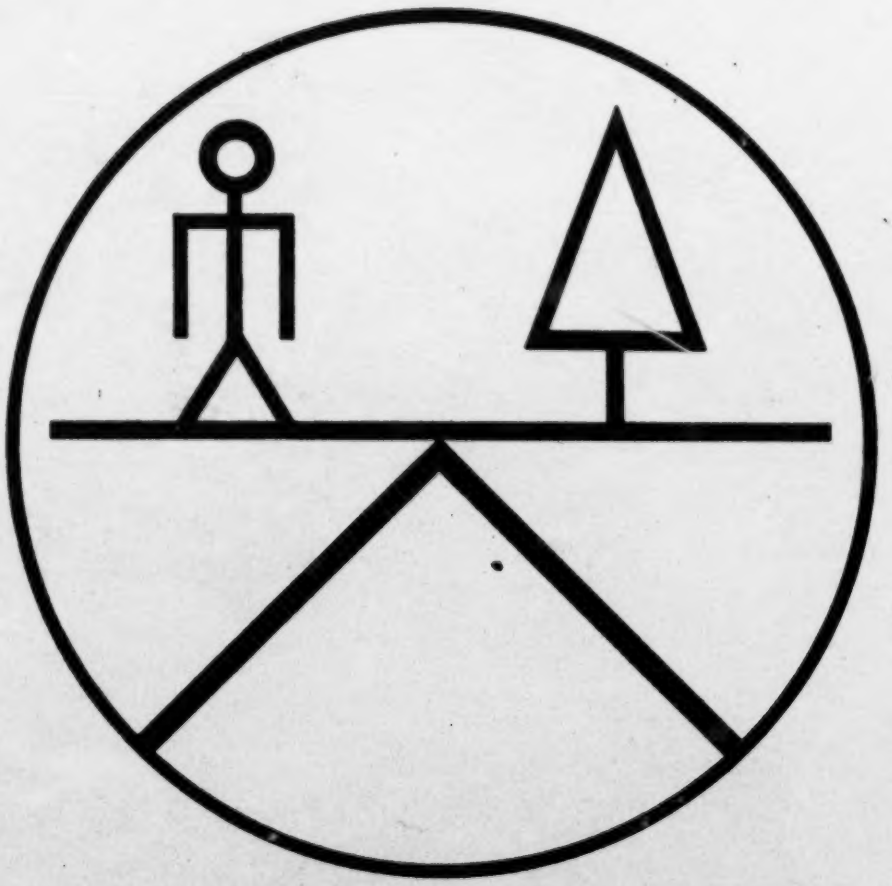
ABSTRACT

These career ladders, developed by state, federal, county, and college personnel, have been designed to enable postsecondary students to prepare for entrance into environmental health occupations at a level commensurate with their abilities where they will be capable of meaningful contributions and can obtain advanced standing in employment. Program descriptions are provided for: (1) environmental aide, a 12-month course for the pre-community college, high school graduate which includes field work, basic skills, laboratory skills, and academic development, (2) associate degree program in chemical technology or environmental science, and (3) baccalaureate program in environmental sciences technology, which is designed to enable the community college graduate in environmental science to continue to specialize. Course outlines, consisting of main topics, number of lecture periods, objectives, and other information, are provided for the environmental aide and associate degree programs, while prerequisite and completion credits are listed for the baccalaureate program. A bibliography is included. (SB)

EDO 47097

153p+ C1

CAREER LADDERS IN
ENVIRONMENTAL HEALTH



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ERIE COMMUNITY COLLEGE
Buffalo, N.Y.

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CAREER LADDERS IN ENVIRONMENTAL HEALTH

A PROJECT SUPPORTED BY FUNDS PROVIDED

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VEA 70-2-386

AT

ERIE COMMUNITY COLLEGE
BUFFALO, NEW YORK 14221

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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INTRODUCTION

This document reflects the efforts of the project staff and others in developing "Career Ladders in Environmental Health" for post-secondary students. Hopefully its application will enable an individual to prepare himself for entrance to society and the world of work at a level commensurate with his abilities. At any stage of the ladder he will be capable of a meaningful contribution to the fight on ecological decay and obtain advanced standing in employment in both the public and private sectors.

Special emphasis has been given to course descriptions in Environmental Science contrasted to the more typical academic offerings.

The appreciation of the staff goes to the Occupational Education Section of the State Education Department for approving the project and channeling the VEA funds to the College.

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BACKGROUND

One of the unique functions of a Community College is its ability to adapt its offerings to the current and changing needs of society. This flexibility is necessary so as to provide the technical manpower during the fact rather than after. Erie Community College has met this challenge in the past, especially in the field of Allied Health. The record shows that in the last ten years five new programs in the Allied Health field have been initiated and continue to function. They include Medical Laboratory, Nursing, Inhalation Therapy, Recreation Supervision, and Occupational Therapy.

The nation and the world have become painfully aware of the damage we have done to our environment as a whole and a global crusade has been launched to reverse the deterioration of our God-given heritage. To accomplish the reversal, two essential elements are necessary; money and trained manpower. Institutions, such as Erie Community College, must assume the responsibility for training young men and women to carry out the crusade in a scientific and professional manner. The basic ingredient for a large share of this training is already available in the Departments of Chemical Technology and Bio-Medical Science. Add to these the necessary specialty offerings in Environmental Science and we have the means to the desired end.

During the latter part of 1966 this program was initially investigated but unfortunately was abandoned because of lack of interest. In June of 1969 this author renewed the investigation by contacting officials of the Consumer Protection and Environmental Health Service of the U.S. Public Health Service. A series of meetings which rapidly expanded in scope led to a realization that the need for such a program was immediate. State, Federal, County, and College officials agreed upon the series of courses which would best suit the needs of the Niagara Frontier and prepare the student for meaningful employment.

An independent group of individuals from various units of the State University met at the State University of New York Water Resources Center to consider such training on a state-wide basis. The general consensus was that it would be undesirable to proliferate such programs for a number of reasons. It was felt that the shortage of competent teachers in the field would impair the quality of offerings and the present number of job openings would not accommodate a multitude of programs throughout the state. The establishment of a program in a general zone of the state to provide for local needs appeared to be the best course of action. This would limit such curricula to six of the community colleges.

Officials of the State University College at Buffalo have reviewed the program and are eagerly awaiting its first graduates for admission to the Environmental Sciences Technology baccalaureate program recently established. They have also expressed an interest in reciprocal use of facilities and faculty.

The State University Urban Center in Buffalo, which is administered by Erie Community College was contacted in regard to a training program for its students. The scientific and industrial communities were surveyed as to the most appropriate training program which would enable Urban Center students assume meaningful positions in environmental health. Those students who demonstrate an aptitude and ability for further academic work will be encouraged to enroll at Erie Community College in its Environmental Health program leading to the Associate degree.

By affording opportunities at various levels of ability, the educational community cannot only provide the human resources for the war on the dissipation of the earth, but also let each become all he is capable of being in a dynamic field of employment.

RELATED PROGRAMS

For an educational institution to involve itself in the Environmental health field it must either be ready to commit a large sum of money in laboratories, equipment, and highly trained faculty, or it must have them already available. The Chemical Technology curriculum has held a prominent place on the campus of Erie Community College for over 22 years and fortunately can provide the necessary facilities, equipment, and highly qualified faculty to accomplish a major share of the basic education in environmental health. The Bio-Medical Department may be utilized to provide the basic preparation in biology and ecology. The remaining specialty courses will require the procurement of equipment and qualified faculty, then the program will be complete.

Similar programs are offered at Delhi, Broome, Hudson Valley, and Morrisville in New York State. Unfortunately these programs have achieved limited success in terms of the number of graduates produced. Nationally there are a few junior colleges engaged in this work. The fact is that presently no such program is in operation, at any level, in Western New York which contains a million and a half people, is highly industrialized, borders on Lake Erie, and is in serious ecological trouble.

The State University of New York College at Buffalo is also in a unique position to initiate its program in Environmental Science with not only similar facilities to those at Erie Community College with regard to Chemistry and Biology, but in addition the "Great Lakes Laboratory", which SUNY/CAB operates. The baccalaureate program, which will begin in September 1970, already has an effective research-field training facility of considerable national esteem.

The program to be offered at the Urban Center will have to be built from "scratch". With the aid of the two senior institutions this should be accomplished rapidly.

OCCUPATIONAL OUTLOOK

Recognizing the gravity of the pollution situation and the massive efforts required to reverse the process of decay, it is not hard to grasp the great numbers of qualified technicians that will be necessary to carry on the fight. In a 1968 issue of "Environmental Science and Technology" (2(8):587), the following table appeared projecting the national need for technicians with less than a baccalaureate degree.

Employers	1967	1972	Increase	% Increase
State Agencies	317	980	663	209
Local Agencies	2,250	5,500	3,250	114
Industrial Agencies	1,700	6,000	4,300	247
Consulting Engineering	6,000	21,000	15,000	250
TOTAL	10,267	33,480	23,213	225

In Western New York by 1972, 65 additional municipal sewage and water treat plant operators will be needed. With new water quality standards going into effect, approximately 130 technician positions in private industry will have to be filled according to the New York State Department of Health.

In regards to air pollution, most estimates call for a two to three fold increase of our present work force at the technician level by 1975. (Environmental Science and Technology, 1968 2(12: 1078). Within Western New York, there will be approximately 100 jobs created within the next five years in the field of air quality monitoring and pollution abatement.

As the momentum of the war on pollution increases and necessary statutes enacted, the employment picture will expand rapidly.

The types of occupations which graduates of the various levels would pursue include:

Research and Development Technician

Sales and Service Technician

Sewage Treatment Plant Operator

Water Treatment Plant Operator

Regulatory Technician

Design and Construction Technician

Engineering Aide

Sanitarian Aide

Stream Sanitation Technician

Environmental Technician

Milk Inspector

Radiological Technician

Air Pollution Technician and Engineer

Food Inspector

Public Health Technician

Industrial Waste Technician

School Sanitation Inspector

Rodent Control Technician

Solid Waste Technician

These jobs would be filled in the following agencies:

County and City Health Departments

State Health Department

State Department of Agriculture and Markets

Housing and Urban Renewal Agencies

Colleges and Universities

Dairy Processors

Food Processors

Restaurant Chains

Motel and Hotel Chains

Manufacturers

Municipal Sewage Departments

Municipal Water Departments

Public Health Laboratories

Engineering Firms

Industrial Concerns

The Environmental Science graduate would also be qualified to fill many other positions not necessarily in the Environmental field.

ENVIRONMENTAL AIDE PROGRAM

This program is designed for the pre-community college high school graduate whose background in science and mathematics is weak, but has an interest in environmental work. Primary emphasis will be geared towards the youth of the inner-city. The program stresses application of information rather than knowledge for knowledge sake. The structure of such a program must lend itself to the total involvement of the student so as to garner a knowledge of the terminology, mathematical skills and basic science which is required to operate effectively as an aide or to pursue a degree from the community college. The program progresses from a semi-structured problem oriented session to the traditional lab class instruction. The program also deviates from traditional academic patterns to take advantage of seasonal changes.

The Environmental Aide program involving 15 students would be broken into three distinct stages; July through November - field work and basic skills; December through March - laboratory skills and academic development; April through June - academic development and application. Each of these stages are furthered explained below.

July through November

The group of 15 students would receive one week of orientation to the environmental health field. This orientation would take place at the Urban Center and the Great Lakes Laboratory. They would receive a comprehensive picture of problems and the resources available for their remedy. The students would be introduced to basic biology, chemistry and physics laboratory and field skills. Instruction is followed by practicum and discussion. As further reinforcement, students will be assigned duties in one of the several on-going research projects conducted by the lab. They will work directly with the researchers who will, in the process of the investigation, instruct the student in the basic mathematical reading and writing skills, physical and biological skills which apply to the work. Students will also be given the opportunity to observe and participate in municipal and industrial programs.

December through March

During the winter session the students will spend more time in the laboratory and the classroom. In the latter they will begin to receive formal training in mathematics, physics, chemistry and biology. These courses will be introductory in nature and will be integrated not only with respect to each other's inter-relationships but also with the experience and knowledge gained in stage one. The lab work, physics, chemistry and biology will utilize samples and problems encountered in the field experinece.

April through June

With less harsh weather the students will spend more time in the field. Again they will be participating in "real life" environmental projects. There will be assigned tasks to perform in their entirety under decreasing supervision. Reinforcement of techniques and application of knowledge gained in formal training will be stressed. Trainees will be given additional class instruction in mathematics, physics, chemistry and biology. They also will participate in a seminar in which the relevance of the class material will be discussed. Upon completion of the program each student will be evaluated and counseled as to whether he should seek employment at this point or move on to the community college. The program would be administered by the community college in conjunction with the Urban Center and State College through its Great Lakes Laboratory. Each of these agencies have participated in the development of the program. Assistance in locating a rewarding position will be given to the graduates of the program.

COURSE OUTLINE

A. Course Title and Number: Environmental Aide Math

B. Curriculum Name: Environmental Aide

C. Number of Class Periods: Three class hours per week for 16 weeks

D. Textbook Used:

E. Prepared By: Knute H. Holmberg, Director of Institutional Research, May 1970

F. Objectives: To review and strengthen the students' knowledge of the fundamentals of arithmetic and basic algebraic skills. The material will be presented in an applied sense to indicate its relevance to Environmental Science. The course will prepare the student for college mathematics.

NO. OF LECTURE PERIODS	MAIN TOPICS
12	Numerical Computations and Operations
8	Exponents and Radicals
15	Basic Algebraic Operations
5	Equations
8	Logarithms and Introduction to Trigonometry

WEEK	TOPICS
1 & 2	Introduction 1. Description of course and purpose 2. The number system 3. Addition and Subtraction 4. Multiplication

WEEK	TOPICS
3 & 4	Arithmetic Operations 1. Division 2. Fractional Operations 3. Mixed number operations 4. Squares and square roots
5 & 6	Exponents and Radicals 1. The laws of exponents 2. Numerical exponential operations 3. Radicals 4. Fractional exponents
7 & 8	Fundamentals of Algebra 1. The Nature of Algebra 2. Addition and Subtraction 3. Multiplication 4. Multiplication of Multinomials
9 & 10	Algebraic Operations 1. Division 2. Division of a multinomial by a monomial 3. Special Products 4. Simple Factoring
11 & 12	More Algebra 1. Lowest Common Multiple 2. Fractions 3. Combined Operations
13 & 14	Equations 1. Introduction 2. Solving Equations 3. Quadratic Equations
15 & 16	Other Topics 1. Logarithms 2. Logarithmic Operations 3. Angles 4. What is Trigonometry

COURSE OUTLINE

A. Course Title and Number: Environmental Aide Physics

B. Curriculum Name: Environmental Aide

C. Number of Class Periods: Three lecture hours, 2 lab hours per week for 16 weeks

D. Textbook Used:

E. Prepared By: Knute H. Holmberg, Director of Institutional Research, May 1970

F. Objectives: To acquaint the students with the laws of physics and their interrelationship with all sciences. The course will be taught in an applied sense utilizing and relating to the student's previous experience.

NO. OF LECTURE PERIODS	MAIN TOPICS
12	Mechanics
12	Heat
12	Electricity
8	Light and Optics
4	Atomic and Nuclear

WEEK	TOPICS
1 & 2	Introduction to Physics 1. Introduction to course 2. Measurement and reference frames 3. Elasticity 4. Mass

WEEK	TOPICS
3 & 4	<u>Statics and Dynamics</u> 1. Vectors and Force 2. Equilibrium 3. Velocity, Acceleration, Momentum 4. Gravity
5 & 6	<u>Heat</u> 1. Energy 2. Temperature 3. Specific Heat 4. Expansion
7 & 8	<u>More Heat</u> 1. Phase Changes 2. Gas Laws 3. Heat Transfer
9 & 10	<u>Electricity</u> 1. Nature of electricity 2. Electric charge 3. Fields 4. Magnetism at work
11 & 12	<u>Current</u> 1. The ampere 2. Resistance 3. Ohm's Law and EMF 4. Simple motors
13 & 14	<u>Light</u> 1. The nature of light 2. Electromagnetic radiation 3. The spectrum 4. Relfection and refraction
15 & 16	<u>Atomic and Nuclear</u> 1. The atom 2. Radioactivity 3. Elementary particles 4. Measurement

LABORATORY

1. Measurements and error
2. Hooke's Law
3. Force table
4. Simple machines
5. Expansion
6. Specific Heat
7. Phase Changes
8. Gas Laws
9. Magnetism
10. Electrical measurement
11. Circuits
12. Circuits
13. Measurement of light
14. The Spectrum
15. Films on A-N physics

COURSE OUTLINE

A. Course Title and Number: Environmental Aide Chemistry

B. Curriculum Name: Environmental Aide

C. Number of Class Periods: Three class periods per week - one semester

D. Textbooks Used: Introduction to General Chemistry, J. K. Homes, 1st. Edition
C. V. Mosby Company

Prerequisite to College Chemistry, R. S. Drago; Harcourt, Brace and World

E. Prepared By: Gerald R. Wagner - Professor - September 1969

F. Objectives: A descriptive chemistry course dealing with fundamental concepts; scientific methods; atomic and molecular structure; nomenclature; kinetic motion; periodic law; solutions; selected elements.

NO. OF LECTURE PERIODS	MAIN TOPICS
2	Introduction
2.	Metric System
2	Kinds of Matter
2	Elements and Compounds
2	Ionic Bonding
3	Equations and Reaction
2	Hydrogen, Oxygen
3	Ionic Equations

NO. OF LECTURE PERIODS	MAIN TOPICS
3	Gases and Kinetic Theory
2	Physical Nature of Matter
2	Covalent Bond
2	Periodic Systems
3	Heat and Calorimetry
3	Oxidation-Reduction
2	Solutions, Colloids
3	Selected Elements
3	Hour Examination
6	Lecture Demonstrations

TOPICS

Introduction
1. Sciences
2. Scientific Methods
3. Chemistry
4. History

Metric System
1. Weight
2. Volume
3. Length
4. Temperature Measurement

Demonstration 1

Kinds of Matter
1. Elements, Mixture, Compounds
2. Laws of Multiple Proportions
3. Symbols
4. Atomic Weight
5. Empirical Formulas

Demonstration 2
Demonstration 3

Elements and Compounds
1. Isotope
2. Electron Configurations
3. Electron Orbitals
4. Covalent Bonds

Ionic Bonding
1. Electron Transfer
2. Valence
3. Ionic Radicals
4. Oxidation Number
5. Compound

Reaction and Equation
1. Stoichiometry
2. Gram Molecular Weight

TOPICS

Hydrogen-Oxygen-Water
1. Chemical Properties
2. Water — Demonstration 4
3. Acid and Bases
4. Molar Solutions — Demonstration 5
5. Salts and Buffers

Ionic Equation
1. Reversible Reactions — Demonstration 6
2. Ionic Equations
3. Solubilities — Demonstration 7
4. Reaction Completion

Gas and Kinetic Theory
1. Properties
2. Ideal Gas Laws — Demonstration 8
3. Pressure Relationship
4. Valence Relationship — Demonstration 9
5. Temperature Relationship
6. General Gas Law — Demonstration 10
7. Dalton Law
8. Molecular Weight Determination

Physical Nature of Matter
1. Solid - Crystalline and Amorphous
2. Liquid - Liquid Expansion — Demonstration 11 & 12

Covalent Bonds
1. Compound of Carbon — Demonstration 11
2. Halogen Compounds
3. Ammonia
4. Complex Ions

Periodic System
1. Historical
2. Comparison of Compounds
3. Periodic Chart

Heat and Calorimetry
1. Heat Energy — Demonstration 12
2. Measurement of Heat — Demonstration 13
3. Calorimetry
4. Energy of Activation

Oxidation - Reduction
1. Oxidation Numbers — Demonstration 14
2. Balance of Redox Equations
3. Ion-Electron Balancing of Equations
4. Comparison of Reactions
5. Oxidation Potential

Solutions
1. Volume Percent
2. Weight Percent
3. Weight Volume
4. Molar Solution
5. Normal Solution
6. Colloids

Selected Elements
1. Atmospheric Elements — Demonstration 15
2. Oxides of Elements
3. Alkali Metals - Alkaline Earths
4. Group III Metals
5. Group IV Elements — Demonstration 16
6. Group V Elements
7. Group VI Elements
8. Transition Elements

SELECTED DEMONSTRATIONS

1. Metric Measurements
2. Preparation of Compound
3. Simple Chemical Reaction
4. Distillation of Water - Freezing of Water - Electrical Conductivity
5. Titration of Acid and Base
6. Ionic Reactions - Silver and Chloride Ions
7. Solubilities Reactions
8. Pressure Measurements
9. Valence Measurements
10. Combine Pressure and Volume
11. Physical Properties of Substances - Compounds and Mixtures
12. Molecular Weight Determination
13. Conductivity and Physical Properties of Covalent and Ionic Compounds
14. Kinetic Motion as a Function of Heat
15. Specific Heat of Metals
16. Redox Reactions
17. Cation Test
18. Properties of Halogens

COURSE OUTLINE

A. Course Title and Number: Environmental Aide Biology

B. Curriculum Name: Environmental Aide

C. Number of Class Periods: Three lecture periods and one 2 hour laboratory period per week for 16 weeks.

D. Textbook Used: Biology, Its Principles and Implications, Hardin, Freeman Company

The Science of Biology, 3rd Edition, Laboratory Manual, Weisz, McGraw-Hill

E. Prepared By: Knute H. Holmberg, Director of Institutional Research, June 1970

F. Objectives: To provide the students with a basic understanding of biology and its application to Environmental Science.

NO. OF LECTURE PERIODS	MAIN TOPICS
4	The Scientific Method
4	Origin of Life and Matter
5	Cell Theory
6	Molecular Biology
9	Plants
3	Ecology
7	Genetics and Evolution
10	Animals and Animal Systems

WEEKS	TOPICS
1	The Scientific Method 1. Observations, Theory, Experimentation 2. Control 3. Statistics and Their Meaning
2 & 3	Life and Matter 1. The Formation of the Solar System 2. Basic Chemistry 3. The Origin of Life
4.	Cell Theory 1. Structure and Process 2. Mitosis
5 & 6	Molecular Biology 1. Compounds 2. Respiration 3. Thermodynamics 4. Regulatory Systems
7 & 8	Plants 1. Green Plants a. Photosynthesis b. Classification c. Carbon Cycle, Nitrogen Cycle, etc. 2. Non Green Plants a. Fungi b. Bacteria
9.	Ecology 1. Food Chains 2. Energy 3. Ecological Balance

WEEKS	TOPICS
10 & 11	Genetics 1. Classical and Molecular 2. The Genetic Process 3. Interactions 4. Evolution a. Fossils b. Theories c. Chordates
12 - 16	Animals and Animal Systems 1. Respiration 2. Digestive 3. Nervous 4. Behavior 5. Circulatory 6. Endocrine 7. Muscular 8. Reproductive 9. Disease

LABORATORY

1. Cells: Microscopic Structure
2. Cells: Tissues and Organs of Plants
3. Cells: Tissues and Organs of Animals
4. Physical Processes
5. Minerals and Carbohydrates
6. Lipids and Pigments
7. Proteins and Acids
8. Enzymes
9. Respiration
10. Photosynthesis
11. Anatomy of Plants
12. Mitosis and Meiosis
13. Digestion
14. Blood and Circulation Systems
15. Nervious System
16. Frog

ASSOCIATE DEGREE PROGRAM
CHEMICAL TECHNOLOGY
ENVIRONMENTAL SCIENCE OPTION

The Chemical Technology curriculum provides theoretical and practical training for men and women who wish to prepare for technical, production, and supervisory positions in the chemical field. Graduates are well qualified to hold positions such as research assistants, analysts, technical salesmen, technicians in process development, and supervisors in the chemical operator's field.

Men and women trained as chemical technicians have become essential members of the scientific team in chemical research, production and pilot-plant operation. These chemical technicians work as key assistants to research chemists and as engineering aides to chemical engineers. The chemical technician's work involves the application of knowledge of chemical processes and the techniques of chemical analysis and control.

In order to prepare the student for the technician field, the Chemical Technology curriculum provides training in chemical, physical and mathematical theories and principles. Laboratories equipped with modern instruments and equipment allow the students extensive and varied training in the practical techniques necessary in chemical research, development, and production.

Applicants for the Chemical Technology curriculum should have completed three years of mathematics, chemistry, and physics in high school.

Upon completion of his first year of study, the student may opt to continue in Chemical Technology or "track off" in Environmental Science.

The Environmental Science program prepares a student in biology, sanitation, control, treatment and operation through a series of highly specialized courses. This course of study does not necessarily restrict the student to Environmental occupations for he is, upon graduation, a thoroughly trained scientific technician capable of functioning in many areas.

CHEMICAL TECHNOLOGY CURRICULUM

(Environmental Science Option)

FIRST YEAR

First Semester

	Course	Class Hrs.	Lab Hrs.	Credit Hrs.
116/120	Mathematics	4	-	4
220	General Chemistry	3	-	3
260	Physics	3	2	4
410/450	English	3	-	3
1301	Quantitative Chemistry	-	3	1
		13	5	15

Second Semester

	Course	Class Hrs.	Lab Hrs.	Credit Hrs.
119/121	Mathematics	4	-	4
222	General Chemistry	3	-	3
261	Physics	3	2	4
411/451	English	3	-	3
1303	Qualitative Chemistry	-	3	1
		14	5	15

SECOND YEAR

First Semester

Course	Class Hrs.	Lab Hrs.	Credit Hrs.
Biology	3	2	4
Sanitary Chemistry	3	3	4
Water Supply Treatment & Distribution	3	3	4
Environmental Science Seminar I	-	2	1
Environmental Elective	2	3	3
	11	13	16

Second Semester

Course	Class Hrs.	Lab Hrs.	Credit Hrs.
Social Science	3	-	3
Instrumentation (Environmental)	1	3	2
Microbiology	3	3	4
Wastewater Collection Treatment & Disposal	3	3	4
Environmental Science Seminar II	-	2	1
Environmental Elective	2	3	3
	12	14	17

		Class Hrs.	Lab Hrs.	Credit Hrs.
116	ELEMENTARY FUNCTIONS			

Axioms of the real numbers; functions; exponential, trigonometric, inverse, exponents; complex numbers; variations; linear equations; quadratic equations; vectors; angles and trigonometric functions; introduction to conics and analytic geometry, probability, mathematical induction, brief introduction to calculus, elements of solid geometry. Prerequisite: A minimum of three year's high school mathematics.

119	SURVEY OF CALCULUS	4	0	4

Application rather than the development of the calculus will be stressed. The topics to be included are: Rate of change; area under a graph; slope; derivatative; differentials; increments; problem solving; maxima and minima; derivatives of transcendental functions; parametric equations; motion velocity. Prerequisite: Math 116.

120	CALCULUS AND ANALYTIC GEOMETRY	4	0	4

Differentiation and integration of algebraic and trigonometric function; applications, analytic geometry. Prerequisite: N.Y.S. Math 11 or Math 116.

121	CALCULUS AND ANALYTIC GEOMETRY	4	0	4

Differentiation and integration of transcendental functions; hyperbolic functions; methods of integration; additional analytic geometry topics. Prerequisite: Math 120.

220	GENERAL CHEMISTRY	3	0	3

Mathematical fundamentals; review of physical concepts. Chemical fundamentals-chemical terminology; states and classification of matter-atomic theory; gases, behavior and laws -- study of states of matter, chemical equations and chemical arithmetic -- chemical periodicity -- electronic structure of atoms, quantrum approach; types of chemical bonds; solutions.

222	GENERAL CHEMISTRY	3	0	3

Chemical equilibrium in gases; ionic solutions, conductance, net ionic equations, oxidation-reduction equations, electrolysis, Faraday's Law, galvanic cell and driving force of chemical reactions -- acid and bases, theories; calculation of ionic equilibrium, pH, hydrolysis, buffer, solutions, indicators, solubility products -- nuclear chemistry -- chemical kinetics -- transition metal complexes -- selected advanced topics. Prerequisite: Chemistry 220.

		Class Hrs.	Lab Hrs.	Credit Hrs.
260	PHYSICS	3	2	4

A course in general physics intended for the technology student. Topics include vectors, linear and circular motion, laws of motion, friction, conservation laws, simple machines, properties of matter, fluids, sound calorimetry, thermodynamics, heat transfer.

261	PHYSICS	3	2	4

Electrostatics, Ohm's Law, simple electric circuits, magnetism, induction, alternating current, light, geometrical optics, optical systems, physical optics, relativity, quanta atomic theory, solid state theory, nuclear structure and transformation. Prerequisite: Physics 260.

410	COMPOSITION AND INTRODUCTION TO LITERATURE	3	0	3

Composition techniques developed through the reading of the short story, essay and novel. Writing assignments will entail analysis of works read.

411	COMPOSITION AND INTRODUCTION TO LITERATURE	3	0	3

Written comments on literature based upon readings in poetry, drama, and the novel. Emphasis on the techniques of analysis of the works read.

450	EFFECTIVE COMMUNICATION	3	0	3

Study and writing of effective business communication with emphasis on letters of application, inquiry, and purchase. Development of reading and compositional skills. Development of speaking skills and methods of oral delivery with emphasis on persuasion, informative presentations, small group discussions, and effective listening.

451	ORAL AND WRITTEN REPORTING	3	0	3

Background data on types and styles of reports. Clarity, conciseness and completeness as attributes of the report. Use of definitions, descriptions, classifications and interpretation in reporting. Industrial and technical application.

1301	QUANTITATIVE CHEMISTRY LABORATORY	0	3	1

An introduction to quantitative techniques and physio chemical measurements including gravimetric determinations, molecular weight determinations, spectographic examinations. Prerequisite: Co-registration Chemistry 220.

		Class Hrs.	Lab Hrs.	Credit Hrs.
1303	QUALITATIVE CHEMISTRY LABORATORY	0	3	1

Principles of qualitative analysis; systematic separation and identification of anions-alkali metals, alkaline-earth metals, selected transition elements; homogeneous equilibrium; chromatography-paper and thin layer. Prerequisite: Co-registration Chemistry 222.

	ENVIRONMENTAL HEALTH SEMINAR (I, II)	0	2	1

Introduces student to the basic concepts of environmental health and the impact of man on his total environment. The philosophy and history of public health will be included as will studies of programs and activities of governmental agencies in such areas as radiological health, epidemiology and pest control. Various instructional methods including visiting lecturers, field trips, literature research and laboratory experimentation will be employed.

	BIOLOGY	3	2	4

A basic course in biology including biochemical and biological evolution; cellular function and ultrastructure and levels of organization. Emphasis will be placed on microorganisms and laboratory identification and differention of organisms significant to environmental health.

	SANITARY CHEMISTRY	3	3	4

Includes study in the chemistry of water, foods, wastewater, insecticides and air contaminants in their relationship to environmental health. Laboratory procedures pertinent to each field are practices.

	WASTEWATER COLLECTION, TREATMENT & DISPOSAL	3	3	4

Construction and maintenance of collection systems are studied. Subject matter will also include the operation aspects of wastewater treatment processes, emphasizing biological and tertiary units and the consideration of disposal problems. Laboratory projects include: diagramming a wastewater collection system including plan and profile; preparation of flow diagram various treatment processes; review of operating records of a treatment plant, examining efficiency, costs and operational problems.

	INSTRUMENTATION (ENVIRONMENTAL)	1	3	2

The application, maintenance and calibration of instruments essential to study and control of the environment are considered. Instruction will include characteristics, accuracy and limitations of mechanical, electrical hydraulic and pneumatic sensing equipment.

	Class Hrs.	Lab Hrs.	Credit Hrs.
MICROBIOLOGY (ENVIRONMENTAL)	3	3	4

Considers the classification of microorganisms; protozoa, fungi, viruses; microscopy; bacterial physiology, sapronphytic bacteria; culture media and methods; sterilization and disinfection; germicides; sources of infection; microbes and disease. The study of pathogenic bacteria associated with water and food, natural and acquired resistance to bacteria and respiratory disease-producing microbes is also included.

WATER SUPPLY, TREATMENT AND DISTRIBUTION	3	3	4

Considers water conservation and sanitary protection of water supplies. The various treatment processes including coagulation, sedimentation, filtration and chlorination are studied from an operational viewpoint. Basic hydraulics will be considered in relationship to pipe sizing and pumping installations. Water main construction, storage tanks, valves and hydrants will be studied. Laboratory projects include: determination of yield of a watershed; selection of proper pipe sizes for distribution mains and observation of a local water treatment plant pertaining to work orders, follow-up and records.

COURSE OUTLINE

A. Course Title and Number: Math 116 - Elementary Functions

B. Curriculum Name: Inter-Disciplinary

C. Number of Class Periods: Four class hours per week for 16 weeks

D. Textbook Used: Algebra and Trigonometry, Rees and Sparks, 2nd edition, McGraw-Hill

E. Prepared By: Donald D. Webster, Professor, June 1969

F. Objectives: To instruct the student in Algebra, Trigonometry and Modern Math Notation.

NO. OF LECTURE PERIODS	MAIN TOPICS
3	Sets and Set Notation
5	The number system and fundamental operations
4	Fractions
5	Linear and Fractional Equations
4	Exponents and Radicals
6	Functions and Graphs
5	Angular measure and the trigonometric functions
2	Fundamental identities
2	Reduction, use of tables
2	Graphs of the trigonometric functions

NO. OF LECTURE PERIODS	MAIN TOPICS
6	Quadratic Equations
5	Systems of Equations
2	Ratio, Proportion, and Variation
3	Logarithms
2	Right Triangles
2	Oblique Triangles
3	Arithmetic and Geometric Progressions
2	Mathematical Induction
1	Binomial Theorem

OTHER READINGS

Contemporary College Algebra and Trigonometry by William L. Hart

Modern Algebra and Trigonometry by Robison

Modern College Algebra by Vance

COURSE OUTLINE

A. Course Title and Number: Survey of Calculus 119

B. Curriculum Name: Inter-disciplinary

C. Number of Class Periods: Four class hours per week for 16 weeks

D. Textbook Used: Calculus with Analytic Geometry, Rees and Sparks, 1st edition, McGraw-Hill

E. Prepared By: Donald D. Webster, Professor, September 1969

F. Objectives:

1. To prepare student for mathematical requirements of other courses.
2. To prepare student for successful performance of technical assignments requiring differential and integral calculus.

NO. OF LECTURE PERIODS	MAIN TOPICS
4	Sets. The number system. Inequalities. Bounds, Functions.
3	Lines. Circles. Rational Functions.
4	Limits. Derivative of a function.
3	Derivatives of the polynomial, product and quotient. Composite function. Implicit function. Chain Rule.
4	Indefinite integral. Motion of falling bodies. Definite integral. Areas. Improper integral.
6	Conics. Application of the derivative.
8	Derivatives of the Transcendential functions.
2	Mean value theorem. L'Hopital's rule.

NO. OF LECTURE PERIODS	MAIN TOPICS
4	Polar coordinate system. Parametric equations.
8	Integration formulas. Application of the definite integral.
6	Infinite series. Convergence. Divergence. Power and Taylor series.
4	Differential Equations.
3	Hour exams

OTHER READINGS

Theory and Problems of Calculus (Schaum's Outline Series) by Frank Ayres

Calculus and Analytic Geometry by G. B. Thomas, Jr.

COURSE OUTLINE

A. Course Title and Number: Math 120 - Calculus and Analytical Geometry

B. Curriculum Name: Department of Mathematics

C. Number of Class Periods: Four class hours per week for 16 weeks

D. Textbook Used: Calculus and Analytic Geometry, Thomas, 4th Edition, Addison Wesley

E. Prepared By: Donald Webster, Professor, September 1969

F. Objectives:

1. Preparation for mathematical requirements of other courses.
2. To teach the student an appreciation for logical sequence, a proficiency in his discipline and enable him to become all he is capable of being through an understanding of mathematics and mathematical operation.

NO. OF LECTURE PERIODS	MAIN TOPICS
12	Rate of Change of a Function
8	Limits
14	Derivatives of Algebraic Functions
12	Applicationsoof the Derivative
18	Integration

WEEK	TOPICS
1, 2, 3	Rate of Change 1. Coordinates and increments 2. Slope 3. Equation of a straight line 4. Behavior of functions 5. Velocity and rates

WEEK	TOPICS
4 & 5	Limits 1. Theorems about limits 2. Limits applied to areas
6 & 7	Derivatives 1. Derivatives of Rational Functions 2. Inverse functions 3. Composite functions 4. Chain rule
8 & 9	Derivatives 1. Differentials 2. Continuity
10 & 11	Applications 1. The sign of dy/dx 2. Related rates 3. The second derivative 4. Maxima and Minima 5. Mean Value Theorem
12 & 13	Integration 1. The definite integral 2. Review of trigonometry 3. Differentiation and integration of trigonometry functions
14	Area under a Curve 1. Computation of area as a limit 2. Areas by calculus
15 & 16	Fundamental Theorem of Integral Calculus 1. The trapeyoidal rule 2. Notation 3. Summary and review

COURSE OUTLINE

A. Course Title and Number: Math 121 - Calculus and Analytical Geometry

B. Curriculum Name: Department of Mathematics

C. Number of Class Periods: Four class hours per week for 16 weeks

D. Textbook Used: Calculus and Analytic Geometry, Thomas, 4th Edition, Addison Wesley

E. Prepared By: Donald Webster, Professor, September 1969

F. Objectives:

1. Preparation for mathematical requirements of other courses.
2. To teach the student an appreciation for logical sequence, a proficiency in his discipline and enable him to become all he is capable of being through an understanding of mathematics and mathematical operation.

NO. OF LECTURE PERIODS	MAIN TOPICS
12	Application of the definite integral
12	Transcendental functions
12	Methods of Integration
8	Plane Analytic Geometry
8	Polar Coordinates
12	Vectors and parametric equations

WEEK	TOPICS
1 & 2	Applications of the Definite Integral 1. Area between two curves 2. Volumes 3. Length of a curve 4. Average value of a function

WEEK	TOPICS
3	Applications 1. The centroid 2. Hydrostatic pressure 3. Work
4 & 5	Transcendentals 1. Trigonometry functions 2. Inverse Trigonometry functions 3. The natural log 4. Exponential functions
6	Hyperbolic Functions 1. Identities 2. Derivatives and integrals 3. The catanary
7 & 8	Methods of Integration 1. Powers of trigonometry functions 2. Method of partial fractions 3. Integration of trigonometry functions 4. Substitutions
9	Improper Integrals 1. Improper integrals 2. Numerical methods
10 & 11	Plane Analytic Geometry 1. Curves and equations 2. Tangents 3. Newton's method for roots 4. The circle, parabola, and ellipse 5. Second degree curves
12 & 13	Polar Coordinates 1. Introduction 2. The angle of the radius vector 3. Plane areas

WEEK	TOPICS
14	Parametric Equations 1. Kinematics 2. Parametrics in analytic geometry
15 & 16	Vectors 1. Components 2. Scalar and vector products 3. Loci in space 4. Quadric surfaces 5. Summary and review

COURSE OUTLINE

A. Course Title and Number: General Chemistry 220

B. Curriculum Name: Chemistry Department

C. Number of Class Periods: Two lecture hours - one recitation hour for 16 weeks

D. Textbooks Used: Fundamentals of Chemistry - A Modern Introduction, Brescia, Arents, Meislich, Turk. "Prerequisites for College Chemistry", Drago.

E. Prepared By: Thomas P. Jehrio, Ass't. Prof., September 1969

F. Objectives: To present a general introduction to the entire science of chemistry; offer a rigorous presentation of coordinated fact and principle; impart a realization that chemistry is an experimental science, that theoretical concepts are valid only if they can be successfully tested by experiment; to present basic concepts and present logically developed principles of bonding, states of matter, atomic structure, the periodic table and chemical arithmetic.

NO. OF LECTURE PERIODS	MAIN TOPICS
3	Introduction; Mathematical Fundamentals; Review of Physical Concepts
4	Atoms and Molecules Atomic Theory Laws of Chemical Change, Atomic and Molecular Weight, Moles, Percent Composition, Empirical Formulas
4	Gases
3	Aggregated States of Matter - Crystal Structure, Liquids, Changes of State, Vapor Pressure, Phase Diagrams, Colloids
3	Chemical Equations and Chemical Arithmetic
3	Electron Structures of Atoms
2	Chemical Periodicity
4	Types of Chemical Bonds

NO. OF LECTURE PERIODS	MAIN TOPICS
3	Hydrocarbons and Their Derivatives
3	Hour Examination
16	Recitation

The third period of each week shall consist of a recitation at which appropriate problems are selected to supplement the lecture material.

WEEK	TOPICS
1 & 2	Introduction 1. General and historical remarks 2. Definition of chemical terms 3. Classification of matter, states of aggregation 4. Energy and its classification Mathematical Fundamentals 1. Scientific notation 2. Significant figures 3. Arithmetical manipulation of significant figures 4. Metric system of measurement 5. English - metric conversions Review of Physical Concepts 1. Density and specific gravity 2. Heat and temperature 3. Specific heat 4. Pressure
3 & 4	Atoms and Molecules 1. Law of conservation of matter 2. Law of definite proportions 3. The atomic theory 4. Law of multiple proportions 5. Law of combining volumes 6. Atomic and molecular weights 7. Molecular and gram molecular weights 8. Methods of determining atomic weights (Cannizzaro, Dulong and Pettit, Mass Spectrograph) 9. Percent composition 10. Empirical formula determination

WEEK	TOPICS
5 & 6	**Gases** 1. Ideal gases 2. Charles' Law, Boyles' Law, combined gas law 3. Dalton's Law 4. Molecular volume and Avagadro's Law 5. The Ideal Gas Law - Thermole gas densities, molecular weight 6. Deviations from ideal behavior
7 & 8	**Aggregated States of Matter** 1. Solida, methods of investigation 2. Space lattice, the unit cell 3. Real crystals, lattice defects 4. Liquids and gases 5. Viscosity, surface tension, wetting fluidity 6. Changes of state; warning and cooling curves 7. Vapor pressure and relative humidity 8. Phase diagrams 9. Critical constants 10. Colloids
9 & 10	**Chemical Equations and Chemical Arithmetic** 1. Formulas and valence 2. Nomenclature 3. Balancing chemical equations 4. Weight - weight problems 5. Weight - volume problems 6. Volume - volume problems 7. Limiting factor problems 8. Percent yields
11 & 12	**Electron Structure of Atoms** 1. Electrical nature of matter 2. Thompson and Ruthford, theory of atom 3. Composition of the nucleus 4. Radiation energy and emission spectra 5. Bohr theory 6. Quantization of the energy of an electron

WEEK	TOPICS
11 & 12 (cont'd.)	7. Modification of Bohr theory 8. Atomic orbitals; shells and subshells 9. Energy of an orbital; degeneracy 10. Distribution of electrons in atoms 11. Representation of shapes of atomic orbitals 12. Electron spin - paramagnetism 13. Atomic structure and periodic properties
13	<u>Chemical Periodicity</u> 1. Periodic Law 2. Periodicity of valence 3. Periodicity of chemical properties
14 & 15	<u>Types of Chemical Bonds</u> 1. Lewis symbols 2. Ionic and covalent bonds 3. Multiple bonds 4. Comparison of properties of ionic and covalent bonds 5. Polar bond; electronegativity 6. Exceptions to octet rule 7. Coordinate covalent bond 8. Writing Lew Structures 9. Oxidation number 10. Born - Haber cycle
16	<u>Hydrocarbons and Their Derivatives</u> 1. Bonding of carbon 2. Alkane hydrocarbons 3. Nomenclature of alkanes 4. Isomerism 5. Alkenes and Alkynes 6. Benzene and aromatic compounds

COURSE OUTLINE

A. Course Title and Number: General Chemistry 222

B. Curriculum Name: Chemistry Department

C. Number of Class Periods: Two lecture hours - one recitation hour - for 16 weeks

D. Textbooks Used: Fundamentals of Chemistry - A Modern Introduction, Brescia, Arents, Meislich, Turk.

E. Prepared By: Thomas P. Jehrio, Ass't. Prof., September 1969

F. Objectives: To complete the presentation of fundamental concepts begun in General Chemistry 210 - solutions, equilibria (gaseous and ionic), electrochemistry, acids, and bases.

NO. OF LECTURE PERIODS	MAIN TOPICS
6	Solution Calculations, Concentration, Vapor Pressure, Colligative Properties
3	Gaseous Chemical Equilibrium
3	Ionic Solutions, Conduction, Solvation, Colligative Properties, Oxidation-Reduction Reactions, Faraday's Laws
2	Acids and Bases
5	Acids and Bases, pH, Hydrolysis, Buffer Solutions
2	Slightly Soluble Salts, Solubility Products, Effect of pH, Complexion Formation
3	Electro Chemistry
3	Nuclear Chemistry
2	Chemical Kinetics
3	Hour Exams
16	Recitation

The third period of each week shall consist of a recitation at which appropriate problems are selected to supplement the lecture material.

WEEK	TOPICS
1 - 3	**Solutions** 1. Liquid solution 2. Saturation: Gases in liquids 3. Saturation: Solids in liquids 4. Saturation: Liquids in liquids 5. Dependence of solubility on temperature and pressure 6. Supersaturation 7. Solubility and molecular structure 8. Measures of composition of solutions (Molarity, normality, weight percent, mole fraction, molality, volume percent) 9. Raoult's Law 10. Deviations from Raoult's Law 11. Activity 12. Henry's Law 13. Vapor pressure and equilibrium 14. Deliquescence 15. Vapor pressure depression 16. Boiling point elevation and freezing point depression 17. Osmotic pressure 18. Determination of molecular weight
4 & 5	**Gaseous Chemical Equilibrium** 1. Equilibrium in gases 2. Evaluation of K_c and K_p 3. Change of K with form of equation 4. Combination of equilibrium 5. Conversion of K_c to K_p 6. Principle of Le^r Chatelier 7. Equilibrium and catalysis 8. Heterogeneous equilibrium 9. Law of Partition 10. Equilibrium

WEEK	TOPICS
6 & 7	**Ionic Solutions** 1. Electrical conductance 2. Colligative properties of ionic solutions 3. Degree of dissociation 4. Electronic vs. ionic conduction 5. Solvation 6. Net ionic equations 7. Balancing oxidation-reduction equations 8. Faraday's Law
8	**Acids and Bases** 1. Nomenclature of oxyacids and their anions 2. Bronsted-Lowry concept 3. Amphoterism 4. Lewis Acid-Base Theory 5. Protolysis in non-aqueous media
9 - 11	**Calculation of Ionic Equilibrium (Acid-Base Equilibrium)** 1. Ionization of water 2. ph and pOH 3. Acidic, basic and neutral solutions 4. Ionization of weak acids 5. Ionization of weak bases 6. Conjugate acid-base pairs 7. Polyprotic acids and bases 8. Common - ion effect 9. Hydrolysis 10. Buffer solutions 11. Indicators
12	**Calculations of Ionic Equilibrium (Slightly soluble salts)** 1. Solubility products 2. Effects of pH on solubility 3. Calculation from Ksp

WEEK	TOPICS
13 & 14	Electrochemistry 1. Electricity from a chemical reaction 2. Galvanic cell 3. Measurement of EMF 4. Convention notation fór cells 5. Construction of galvanic cells 6. Predicting the direction of a chemical reaction 7. Dependence of EMF on concentrations 8. The dry cell and the storage cell
15	Nuclear Chemistry 1. Radioactivity 2. Nuclear energy 3. Stability of nuclei 4. Nuclear reactions 5. Rates of radioactive decay
16	Chemical Kinetics 1. Conditions affecting reaction rates 2. Theory of reaction rates 3. Mechanism of reaction from rate equation 4. Catalysis

COURSE OUTLINE

A. Course Title and Number: Quantitative Chemistry 1301

B. Curriculum Name: Chemical Technology

C. Number of Class Periods: One - three hour period per week

D. Textbook Used: Analytical Chemistry, Skoog and West; Holt, Rinehart and Winston

Laboratory Investigation of Concepts in Chemistry, Sterrett, Kennedy and Sparberg; Harper and Row

E. Prepared By: Gerald R. Wagner, Professor, September 1969

F. Objectives: To develop techniques which will teach the student application of theoretical principles which will in turn lead to accurate analysis. To acquaint student with physical measurement equipment and general procedures required to obtain accurate results.

The number of periods spent on any particular experiment shall be left primarily to the student. It is expected that most of the students will finish all of the prescribed work, and some of the ones with faster and better technique may have time to repeat one or two of the analyses, if need be, or work on an extra project.

GENERAL TOPICS

1. Balance
2. Properties
3. Hydrate Analysis
4. Molecular Weight
5. Silver Chloride
6. Chloride Analysis
7. Sulfate Analysis
8. Titrations

MAIN TOPICS	TEXT REFERENCE
1. Physical and Chemical Properties	Sterrett, Kennedy, & Sparberg - P. 25
2. Molecular Weight	Sterrett, Kennedy, & Sparberg - P. 61
3. Preparation of Silver Chloride	Sterrett, Kennedy, & Sparberg - P. 75
4. Techniques and Tools of Gravimetric Analysis	Skoog & West - Ch. 5 - P. 69
5. Gravimetric Determination of Water in Barium Chloride Dehydrate by Volatilization	Skoog & West - P. 155
6. Gravimetric Determination of Chloride in a Soluble Salt Mixture	Skoog & West - P. 156
7. Gravimetric Determination of Sulfate in a Soluble Salt Mixture	Skoog & West - P. 158
8. Titration Acid Base	Sterrett, Kennedy, & Sparberg - P. 111

COURSE OUTLINE

A. **Course Title and Number:** Qualitative Analysis Lab 1303

B. **Curriculum Name:** Chemical Technology

C. **Number of Class Periods:** One - three hour laboratory period per week for 16 weeks

D. **Textbook Used:** General Chemistry Manual - Part II, Raymond B. Andrews

E. **Prepared By:** Thomas P. Jehrio, Ass't. Prof., September 1969

F. **Objectives:** To acquaint student with semi-micro qualitative analysis and chromatography (column, paper, and thin-layer).

NO. OF LECTURE PERIODS	MAIN TOPICS
2	Identification of Substances by Their Properties
1	The Analysis of Group I
1	The Analysis of Group II
1	The Analysis of Group III
1	The Analysis of Group IV
1	The Analysis of Group V
2	General Unknown
1	Problem Session
1	Anion Analysis
1	Column Chromatography
1	Paper Chromatography

NO. OF LECTURE PERIODS	MAIN TOPICS
1	Thin Layer Chromatography
1	Electrophoresis
1	Check-Out and Examination

PERIOD	EXPERIMENT	PAGE
1, 2	Introduction, Identification of Substances by Their Properties	Special Handout
3	The Analysis of Group I	A-11
4	The Analysis of Group II	A-23
5	The Analysis of Group III	A-35
6	The Analysis of Group IV	A-47
7	The Analysis of Group V	A-59
8, 9	General Unknown	A-69
10	Problem Session	
11	Anion Analysis (Known and Unknown)	
12	Column Chromatography	Special Handout
13	Paper Chromatography	Special Handout
14	Thin Layer Chromatography	Special Handout
15	Electrophoresis	Special Handout
16	Check-Out	
	Final Examination	

REFERENCE MATERIAL

Bobbit, Schwarting, Gritter, "Introduction to Chromatography", 1968, Reinhold Book Corporation.

Sterrett, Kennedy, Sparberg, "A Laboratory Investigation of Concepts in Chemistry", 1968, Harper and Row Publishers.

Reilley and Sawyer, "Experiments for Instrumental Methods", 1961, McGraw-Hill Book Company.

Leifield, "Thin Layer Chromatography Principles and Experiments", Mallinekrodt Chemical Works.

FDA - Chemistry Projects - U.S. Department of Health, Education and Welfare.

COURSE OUTLINE

A. **Course Title and Number:** Physics 260

B. **Curriculum Name:** General

C. **Number of Class Periods:** Three class hours per week and two lab hours per week for 16 weeks

D. **Prepared By:** Louis L. Depowski, Ass't. Prof., September 1969

E. **Objectives:** To present a general introduction to physics including vectors, linear and circular motion, laws of motion, friction, conservation laws, simple machines, properties of matter, fluids, sound, calorimetry, thermodynamics, heat transfer.

TOPICS

1. Origins and Growth of Physics
   a. history
   b. the scientific method
   c. physical quantities
   d. measurement, mathematics
   e. reference frames
   f. estimation

2. Matter
   a. phases of
   b. elasticity and Hooke's Law
   c. elastic module
   d. mass, standard of, conservation of
   e. atoms and molecules, elements and compounds

3. Mechanics
   a. vector quantities
   b. force, components
   c. equilibrium problems

4. Particle Kinematics
   a. speed, velocity, acceleration
   b. theory of relativity
   c. problems involving constant acceleration
   d. free fall
   e. ballistics

5. Dyanmics
   a. inertia, inertial systems=
   b. Newton's Law of Motion
   c. application of Newton's Second Law

6. Momentum
   a. Newton's Third Law
   b. impulse and momentum
   c. conservation of linear momentum, center of mass

TOPICS

7. Gravitation
   a. circular motion
   b. contripetal force
   c. Kepler's Law
   d. Universal Law of Gravitation

8. Energy
   a. work
   b. kinetic and potential energy
   c. conservation of energy

9. Kinetic Theory
   a. gas laws, absolute temperature
   b. distribution of molecular velocities

10. Heat Energy
    a. heat quantities
    b. specific heat
    c. change of phase
    d. heat transfer
    e. Joule's Equivalent
    f. Laws of Thermodynamics
    g. entropy

11. Wave Motion
    a. description of waves
    b. the simple pendulum
    c. wave propagation
    d. superposition principle
    e. Doppler effect
    f. standing waves

LABORATORY

1. Measurements, Theory of Error
2. Hooke's Law
3. Equilibrium - Force Table
4. Free-Fall 'g' Measurement
5. Newton's Second Law
6. Elasticity
7. Uniform Circular Motion
8. L = Ia
9. Friction
10. Machines
11. Torsion
12. Gas Laws
13. Specific Heat
14. Fusion Vaporization
15. Expansion
16. Melde's Experiment

COURSE OUTLINE

A. Course Title and Number: Physics 261

B. Curriculum Name: General

C. Number of Class Periods: Three class hours per week and two lab hours per week for 16 weeks

D. Prepared By: Louis L. Depowski, Ass't. Prof., September 1969

E. Objectives: To complete the introduction to physics including electrostatics, Ohm's Law, simple electric circuits, magnetism, induction, alternating current, light, geometrical optics, optical systems, physical optics, relativity, quanta atomic theory, solid state theory, nuclear structure and transformation.

TOPICS

1. Nature of Light
   a. wave properties
   b. laws of reflection
   c. Snell's Law
   d. measurement of the speed of light
   e. dispersion
   f. interference of light waves
   g. diffraction, diffraction grating
   h. polarization

2. Electricity
   a. electric charge, structure
   b. conductors and insulators
   c. Coulomb's Law
   d. electric fields
   e. induction (electrostatic)
   f. electric potential

3. Capacitance
   a. dielectrics
   b. capacitance of certain charge configuration

4. Electric Current
   a. the ampere
   b. resistance
   c. Ohm's Law
   d. simple circuits
   e. Joule's Heating
   f. EMF, energy considerations
   g. sources of EMF
   h. conduction in gases

TOPICS

5. Magnetic fields
   a. magnetic effect of current, moving charge
   b. magnetic field
   c. effect of field on moving charge
   d. force on currents in magnetic fields
   e. generators, motors
   f. magnetic materials

6. Electromagnetism
   a. induced EMF's
   b. Lenz's Law
   c. transformers
   d. electromagnetic waves, propagation
   e. electromagnetic spectrum

7. Quantum Theory
   a. quanta
   b. matter waves
   c. quantization
   d. photoelectric effect
   e. compton effect
   f. position
   g. matter waves
   h. Rutherford's atom
   i. atomic spectra
   j. Bohr's theory

8. Wave Mechanics
   a. indeterminacy
   b. potential
   c. wave function and interpretation

9. Nucleus
   a. structure
   b. potential
   c. radioactivity
   d. the nuclear reactor
   e. fusion
   f. elementary particles

LABORATORY

1. Photometry
2. Image Formation
3. Wave Properties (Tranducers)
4. Diffraction Grating
5. Elementary Circuits
6. Electric Fields
7. Faraday's Law
8. Series - Parallel Circuits
9. Potentionmeter, W. B.
10. Magnetic Fields
11. Ampere's Law
12. A.C. Circuits
13. E/M Experiment
14. Relativity Films
15. Solid State
16. 1/2 Life

COURSE OUTLINE

A. Course Title and Number: English 410 Composition and Introduction to Literature I

B. Curriculum: 1st Year English (1st Semester)

C. Class Periods: Three 50-minute periods a week

D. Textbooks Used:

Hepburn & Greenberg, (ed.), Modern Essays: A Rhetorical Approach, (2nd edition) Macmillan Company, New York 1968

Timko and Oliver, 38 Short Stories, An Introductory Anthology, Alfred Knopf, New York, 1968

Irving Howe, (ed.) Classics of Modern Fiction, Eight Short Novels, Harcourt, Brace and World, Inc., New York City, 1968

E. Prepared By: Program Committee for English 410: J. Harris, D. Roycraft, and D. Warren (Chairman)

F. Objectives:

1. To improve the student's ability to express himself in writing through reading of literature.
2. To improve the student's ability to express himself orally using discussions from readings.
3. To increase the student's ability to understand and appreciate three types of literature.
4. To encourage the students' analytical and critical understanding through written and oral discussion.

WEEKS	TOPICS
3 - 5	Modern Essays, Hepburn & Greenfield
5 - 8	38 Short Stories, Timko & Oliver
2 - 6	Classics of Modern Fiction Eight Short Novels, Irving Howe

I. The Essay

a) Analysis of content of individual essays and discussion of comparative points of view from various authors.

b) Analysis of the essays as comment on Twentieth Century thought.

c) Critical study of the rhetorical structure of the essays through the relation of structure to content
   1. Unity, transition and development
   2. Organization
   3. Point of view and assumptions
   4. Style and tone

   These conclusions to be arrived at by means of written and oral discussion. Short critical papers at regular intervals.

II. The Short Story

The student should become aware of the infinite variety of techniques and the range of materials possible in short fiction through classroom discussion of insights and ideas which is the heart of any learning experience.

Emphasis will be placed on the validity of the experience and expression as evidenced in each story.

The stories are arranged to make possible a comparison of an American story with stories of other national and ethnic settings.

Three critical essays on the nature of the short story will be studied.

Short critical papers will be required at regular intervals.

III. The Novel

While the short story practices a rigid economy of means to achieve a single effect at the end, the novel proceeds discoursively to develop setting, atmosphere and tone as a background for the actions and passions of the characters. Often this is from multiple points of view and realizes the author's intention in a steadily unfolding progression of scenes, events, and states of mind which produce a complex total effect.

Analysis of novelistic techniques in a series of short novels will consequently make the difference from the short story form apparent to students.

Class discussion and short papers required. Areas for special emphasis will be chosen by the participating staff members at the beginning of each semester.

COURSE OUTLINE

A. Course Title and Numbers: English 411 - Composition and Introduction to Literature II

B. Curriculum: 1st Year English (2nd Semester)

C. Class Periods: Three 50-minute periods a week

D. Textbooks Used: Greenfield & Weatherhead, (ed.) The Poem, An Anthology, Appleton-Century-Crofts, New York, 1968

Otto Reinert, Drama An Introductory Anthology, Alternate edition, Little Brown, Boston, 1964.

Irving Howe, (ed.) Classics of Modern Fiction, (continued from first semester).

E. Prepared By: Program Committee for English 410 - J. Harris, D. Roycraft, and D. Warren (Chairman)

F. Objectives:

1. To improve the student's ability to express himself in writing through reading of literature.
2. To improve the student's ability to express himself orally using discussions from readings.
3. To increase the student's ability to understand and appreciate three types of literature.
4. To encourage the student's analytical and critical understanding through written and oral discussion.

WEEKS	TOPICS
6	The Poem, Greenfield & Weatherhead
6	Drama (alternate edition) Otto Reinert
4	Classics of Modern Fiction, Howe (continued from first semester) with allowances for testing and class composition.

I. Poetry

A variety of themes and expressions in lyric and narrative forms of poems past and present will be selected for study.

Meaning, mood, and musical quality will receive the necessary attention for critical appreciation.

(Short critical papers will be required at regular intervals.)

II. Drama

Both literary study of texts and theatrical conditions in a variety of periods and cultures will characterize this brief introductory survey of dramatic form in western civilization.

(Short critical papers will be written at regular intervals.)

III. The Novel

This will be a continuation of the study begun in the first semester.

COURSE OUTLINE

A. Course Title and Number: English 450 - Effective Communication

B. Curriculum Title: General Education

C. Number of Class Periods: Three periods a week

D. Textbooks Used:

1. Preface to Critical Reading, 5th edition, Altick
2. Idea to Delivery: A Handboook of Oral Communication, Garner
3. Xerox Listening Booklet
4. Handy Grammar Reference, Shuster
5. A dictionary

E. Prepared By: Donald E. Peacock, May 1969

F. Objectives: To aid students to read with understanding, to write accurate, well organized prose, to develop poise in front of an audience, and to improve the students' listening ability.

NO. OF LECTURE PERIODS	MAIN TOPICS
20	Public Speaking
10	Principles of Writing
13	Principles of Analysis of Reading Material
5	Listening

A. Denotation and Connotation

1. Connotation in Advertising
2. Connotation in Political Persuasion
3. Connotation in Literature
4. The Importance of Concept

B. Diction

1. Talking the Language of the Audience
2. Jargon
3. The Uses and Abuses of Technical Language
4. Cliches
5. "Newspaperese"
6. Symbols
7. Allusions
8. Irony

C. Sentences and Paragraphs

1. Sentence Length
2. Sentence Arrangement
3. Sentence Rhythm
4. Paragraphs

D. Patterns of Clear Thinking

1. Deductive and Inductive Reasoning
2. Detection of Fallacies
3. Objectivity and Subjectivity
4. The Question of Authority

E. Study of Public Speaking

1. Background to the study of speech
2. Speech outlines and transitions
3. Speech subject, central idea, main points, and supports
4. Title, introduction and conclusion
5. General and special speech situations
6. Vocal aspects of delivery
7. Physical aspects of delivery
8. Language aspects of delivery

F. Review of Mechanics of Writing

1. Sentence and paragraph
2. Sentence fragment
3. Run-on sentence
4. Agreement of subject and verb, noun and pronoun
5. Punctuation
6. Parallelism
7. Modification

G. Practice in Public Speaking (as many types as practicable)

1. Informative speech
2. Motivative speech
3. Impromptu speech
4. Persuasive speech
5. Technical speech for a lay audience
6. Technical speech for a technical audience
7. Demonstration speech

H. Practice in Listening

1. Use of the Xerox Listening Tapes
2. Scoring of the pre-test and post-test

I. A minimum of seven written pages

COURSE OUTLINE

A. Course Title and Number: English 451 - Oral and Written Reporting

B. Curriculum Title: General Education

C. Number of Class Periods: Three - one hour periods per week.

D. Textbook Used: Effective Report Writing, Norman B. Sigband, Harper & Row, 1960

E. Prepared By: Members of the Communication Skills Department, May 1969

F. Objectives:

1. Provide instruction and practice in skills basic to effective communication in report writing.
2. Improve written communication in the following areas; accuracy, unity, clarity, coherence, emphasis, and completeness.
3. Make further application of the principles of oral communication studied the first semester.

NO. OF LECTURE PERIODS	MAIN TOPICS
(Large Group Sessions)	
1	Orientation
1	Mid-Term Exam
10	Content based on material in text or other material relating to report writing.
(Individual Classroom Sessions)	
12	Follow-up material presented in the large group sessions.
12	Correction and discussion of written assignments.
12	Panel discussions (optional).

A. Purpose of Technical Communication

B. Sources of Information

C. Methods of Organization and Outliving

D. Audience Analysis

E. Report Format

1. Letter
2. Memorandum
3. Periodic
4. Final

F. Types of Reports

1. Letter of Application and Inquiry
2. Personal Resume
3. Other Business Letters
4. Recommendation Reports
5. Evaluation Reports

G. Panel Discussions (optional)

H. Minimum of Ten Reports

COURSE OUTLINE

A. **Course Title:** General Environmental Biology

B. **Curriculum Name:** Chemical Technology (Environmental Science Option)

C. **Number of Class Periods:** Three lecture hours, two lab hours per week for 16 weeks

D. **Textbook Used:** Bioscience, R. B. Platt & G. K. Reid, Reinhold Publishing Company

E. **Prepared By:** Robert A. Sweeney, Director, Great Lakes Laboratory, State University College at Buffalo (Erie Community College Curriculum Consultant), June 1970

F. **Objectives:** To acquaint the students with the principles of general biology from an ecological aspect.

NO. OF LECTURE PERIODS	MAIN TOPICS
6	Introduction
12	Populations, Communities & Ecosystems
9	Reproduction
6	Heredity
6	Evolution
6	Taxonomy
3	Man in the Ecosystem

WEEKS	TOPICS
1 & 2	Introduction 1. Scientific method 2. Levels of organization 3. Cell doctrine 4. Gene concept
3 & 6	Populations, Communities & Ecosystems 1. Populations 2. Energy relationships 3. Trophic relationships 4. Biogeochemical cycles 5. Kinds of ecosystems
7 & 9	Reproduction 1. Asexual 2. Sexual 3. Natural regulations
10 & 11	Heredity 1. Mendel's Law 2. DNA-RNA
12 & 13	Evolution 1. Darwinian Theory 2. Natural selection and man
14 & 15	Taxonomy 1. Plant Kingdom 2. Animal Kingdom
16	Man in the Ecosystem 1. Pollution 2. Population 3. Environmental Health 4. Global ecology

LABORATORY

1. Microscope
2. Cells & Tissues
3. Microcosm experiments (Aquatic & Terrestrial)
4. Microcosm experiments (Aquatic & Terrestrial)
5. Microcosm experiments (Aquatic & Terrestrial)
6. Microcosm experiments (Aquatic & Terrestrial)
7. Human Reproduction
8. Mitosis
9. Meiosis
10. Heredity
11. DNA-RNA
12. Evolution
13. Plants
14. Animals
15. Pollution

COURSE OUTLINE

A. Course Title: General Environmental Microbiology

B. Curriculum Name: Chemical Technology (Environmental Science Option)

C. Number of Class Periods: Three lecture hours, two lab hours per week for 16 weeks.

D. Textbook Used:

E. Prepared By: Robert A. Sweeney, Director, Great Lakes Laboratory, State University College at Buffalo (Erie Community College Curriculum Consultant), June 1970

F. Objectives: To acquaint the students with the principles of microbiology from an ecological aspect.

NO. OF LECTURE PERIODS	MAIN TOPICS
6	Introduction
12	Morphology & Physiology
6	Ecology
6	Bacteria
6	Fungi
3	Algae
3	Viruses
3	Protozoa

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WEEKS	TOPICS
1 & 2	Introduction to Microbiology 1. Survey of microbial life 2. History of microbiology 3. Nomenclature and classification
3 & 6	Morphology and Physiology 1. Anatomy 2. Reproduction and gorwth 3. Cultivation 4. Respiration 5. Photosynthesis 6. Chemical changes induced by microbes 7. Modifications, mutations and genitic changes
7 & 8	Microbial Ecology 1. Ecosystem concepts 2. Ecological cycles (carbon dioxide, nitrogen and phosphorus) 3. Ecological ranges 4. Trophic relationships
9 & 11	Bacteria 1. Roles in ecosystem 2. Benefits 3. Problems
12 & 13	Fungi 1. Roles in ecosystem 2. Benefits 3. Problems
14	Algae 1. Roles in ecosystem 2. Benefits 3. Problems
15	Viruses 1. Roles in ecosystem 2. Benefits 3. Problems

WEEKS	TOPICS
16	Protozoa 1. Roles in ecosystem 2. Benefits 3. Problems

LABORATORY

1. Microscope
2. Survey of microbial life
3. Survey of microbial life
4. Biochemical oxygen demand
5. Photosynthesis
6. Light bottle - dark bottle experimentation
7. Cultivation of microorganisms
8. Cultivation of microorganisms
9. Environmental - morphological interactions
10. Environmental - morphological interactions
11. Bacteria
12. Bacteria
13. Fungi
14. Algae
15. Viruses

COURSE OUTLINE

A. Course Title: Sanitary Chemistry

B. Curriculum Name: Environmental Science

C. Number of Class Periods: Three one-hour periods and one three-hour labs per week for 16 weeks.

D. Textbook Used: Sanitary Chemistry For Engineers, Clair N. Sawyer, McGraw Hill Book Company, Inc., New York - Toronto - London

E. Prepared By: Anthony T. Voell, Director Environmental Health Services, Chautauqua Department of Health

F. Objectives: Prospective environmentalists probably have little, if any, knowledge of the sanitary chemistry of water, wastewater, foods, insecticides and air contaminants. This course is designed to provide basic concepts in these categories.

A working knowledge of the laboratory analysis performed on samples collected by the environmental health technician will emphasize the need for proper sample collection and storage. It will also allow the technician to perform routine surveillance tests in the field.

The objectives of this course in sanitary chemistry, then, are summarized as follows:

1. Develop ability to properly collect samples for laboratory analysis.

2. Become familiar with proper documentation that should accompany field samples.

3. Obtain working knowledge of laboratory procedures for sample analysis.

4. Develop ability to perform routine surveillance tests in the field and laboratory analysis.

5. Become familiar with terminology used in sanitary chemistry.

6. Develop talent to interpret results of laboratory analysis.

LECTURE NUMBER	SUBJECT MATERIAL COVERED
1	Course Orientation
2	Basic Concepts from General Chemistry
3	Basic Concepts from Qualitative Chemistry
4	Basic Concepts from Quantitative Chemistry
5	Basic Concepts from Organic Chemistry
6	Basic Concepts from Organic Chemistry
7	Basic Concepts from Organic Chemistry
8	Basic Concepts from Physical Chemistry
9	Basic Concepts from Physical Chemistry
10	Basic Concepts from Colloid Chemistry
11	Basic Concepts from Biochemistry
12	Basic Concepts from Radiochemistry
13	Role of Technician in Collecting and Analyzing Water Supply Samples
14	Turbidity
15	Color
16	Standard Solutions
17	pH
18	Acidity
19	Alkalinity
20	Chemical Coagulation of Water
21	Hardness
22	Water Softening
23	Residual Chlorine and Chlorine Demand
24	Iron and Manganese
25	Flourides
26	Sulfates
27	Introduction to Wastewater Chemistry
28	Chlorides
29	Dissolved Oxygen
30	Biochemical Oxygen Demand
31	Chemical Oxygen Demand
32	Nitrogen
33	Solids
34	Phosphorus and Phosphates
35	Grease
36	Volatile Acids
37	Gas Analysis

LECTURE NUMBER	SUBJECT MATERIAL COVERED
38	Sampling and Analysis of Air Contaminants
39	Sampling and Analysis of Air Contaminants
40	Sampling and Analysis of Air Contaminants
41	Sampling and Analysis of Air Contaminants
42	Pesticides, Insecticides, Herbicides
43	Pesticides, Insecticides, Herbicides
44	Pesticides, Insecticides, Herbicides
45	Statistical Treatment of Laboratory Data
46	Legal Aspects of Sanitary Chemistry
47	Relation of Sanitary Chemistry to Regulatory Agencies
48	Field Tests for Food Contamination

LABORATORY SESSION	SUBJECT COVERED
1	Orientation to Laboratory Procedures
2	Laboratory Exercise on Preparing Standard Solutions
3	Laboratory Analysis on Determinations of Color and Turbidity
4	Laboratory Exercise on Analysis of Acidity, Alkalinity and pH
5	Laboratory Exercise on Tests Performed with Regard to Chemical Coagulation of Water. Possible Field Visit to Water Treatment Plant Laboratory.
6	Laboratory Exercise on Tests to Determine Chemical Needs for Water Softening
7	Laboratory Exercise on Performing Analysis for Hardness
8	Laboratory Exercise on Performing Analysis for Flourides, Sulfates and Chlorides
9	Laboratory Exercise on Sampling and Analysis for Dissolved Oxygen and Biochemical Oxygen Demand

LABORATORY SESSION	SUBJECT COVERED
10	Laboratory Exercise on Sampling and Analysis for C.O.D.
11	Laboratory Exercise on Sampling and Analysis for Nitrogen Compounds
12	Laboratory Exercise on Sampling and Analysis for Solids
13	Laboratory Exercise on Sampling and Analysis for Phosphous, Phosphates and Grease
14	Laboratory and Field Exercise on Analysis of Air Contaminants
15	Laboratory Exercise or Visit to Laboratory that Performs Analysis on Insecticides, Pesticides, etc.
16	Field Exercise on Tests for Contamination of Food Products

COURSE OUTLINE

A. Course Title and Number: Wastewater Collection, Treatment & Disposal

B. Curriculum Name: Environmental Science Option to Chemical Technology

C. Number of Class Periods: Two one-hour periods and one two-hour lab per week for 16 weeks

D. Textbook Used: Water and Wastewater Engineering, Volume 1 & 2, Fair, Geyer and Okum, 1968

E. Prepared By: Anthony T. Voell, Director Environmental Health Services, Chautauqua County Department of Health

G. Objectives: A definite need exists to familiarize environmental health technician personnel (as defined in Part II of the New York State Sanitary Code) with wastewater collection, treatment, and disposal prior to employment. The following areas of concern are proposed for inclusion in this course. Prospective environmentalists will have opportunity to:

1. Develop ability to interpret sewer plans, i.e., slopes, alignments, details.
2. Develop ability to compute capacities of sewers along with associated flow velocities.
3. Obtain basic understanding of pump and lift station design and operation. This would include air ejector, air lift, and centrifugal pumps.
4. Become familiar with details and terminology for house connections.
5. Develop capacity to obtain basic information needed to design and also ability to design private home sewage disposal systems. This would include site inspection, soil percolation tests, soil analysis, plan and specification preparation.
6. Obtain familiarity with basic wastewater treatment processes - primary, secondary, and tertiary treatment, nutrient (N & P) removal, sludge digestion and other methods of handling, chlorination, flow measurement.
7. Develop ability for proper plant evaluation and plant sampling.
8. Obtain working knowledge of stream evaluation for flow, physical characteristics, and chemical and biological parameters.
9. Review wastewater disposal practices to lakes, rivers; groundwater from private homes; intermediate plants and major municipal installations.

10. Obtain understanding of design considerations for intermediate and major wastewater treatment plants including population estimates, design flow volumes and characteristics (strengths) of wastewater.
11. Review methods of disposal of wastewater in recreation areas and marine disposal.

LECTURE NUMBER	SUBJECT MATERIAL COVERED
1	Orientation to Course
2	Wastewater Systems (General Overview)
3	Wastewater Systems
4	Information Analysis
5	Information Analysis
6	Quantities of Wastewater
7	Quantities of Wastewater
8	Elements of Hydrology
9	Wastewater Flow
10	Wastewater Flow
11	Wastewater Collection
12	Wastewater Collection
13	Machinery and Equipment
14	Machinery and Equipment
15	Wastewater Treatment and Disposal
16	Wastewater Treatment and Disposal
17	Wastewater Treatment and Disposal
18	Sludge Treatment and Disposal
19	Sludge Treatment and Disposal
20	Operation and Maintenance of Wastewater
21	Treatment Plants
22	Operation and Maintenance of Wastewater
23	Treatment Plants
24	Analysis of Receiving Watercourse
25	Analysis of Receiving Watercourse
26	Household Sewage Disposal Systems
27	Household Sewage Disposal Systems
28	Wastewater Collection, Treatment, and Disposal in Recreational Areas
29	Wastewater Collection, Treatment, and Disposal in Recreational Areas
30	Industrial Waste Characteristics and Treatment
31	Industrial Waste Characteristics and Treatment
32	Role of Regulatory Agencies in Wastewater Collection, Treatment, and Disposal

LABORATORY SESSION	SUBJECT COVERED
1	Field Trip for Preliminary Look at STP, P.S., Sewers
2	Guest Lecturer to Discuss Use of Statistics in Wastewater System Design
3	Class Problem to Gather Basic Information to Determine Wastewater Quantities
4	Guest Lecturer (Consulting Engineer) to Discuss Design of Sewage Collection Systems
5	Class Problem: Use Information Compiled in Number 3 to Design a Sewer System
6	Guest Lecturer (Plant Operator) to Discuss Operation and Maintenance of Collection System
7	Field Trip to Observe Sewers and their Appurtenances in Detail
8	Field Trip to Wastewater Treatment Plant
9	Field Trip to Observe Sludge Treatment and Disposal Operations
10	Guest Lecturer (Plant Operator) on Wastewater Treatment, Plant Operation and Maintenance
11	Field Investigation of Wastewater Treatment, Plant Operation and Maintenance
12	Field Stream Survey
13	Field Training Exercise on Percolation Tests, Soil Evaluation, Lot Inspection, Reporting of Results
14	Guest Lecturer on Sanitation in Recreation Areas
15	Guest Lecturer on Industrial Wastes
16	Guest Lecturer on Role of Agencies

LECTURE NO. 1

NO. OF LECTURE HOURS: 1

Material Covered: Orientation to Course

Course outline is explained to students. Objectives of course are presented and relationship of laboratories to course is explained. Textbook to be used is presented and course outline handed out.

References:

1. Suggested course textbook

"Water and Wastewater Engineering" - Volume 1 - Water Supply and Wastewater Removal
Volume 2 - Water Purification & Wastewater Treatment and Disposal
Gordon Maskew Fair, John Charles Geyer, Daniel Alexander Akum - Copyright 1968
John Wiley & Sons, Inc., New York

LECTURE NO. 2 & 3

NO. OF LECTURE HOURS: 2

Material Covered:

A general overview of wastewater collection treatment and disposal is presented. Basic wastewater terminology is discussed. Sources of wastewater and collection system patterns are looked at. Preliminary looks are taken at sewage collection methods - storm water collection, collection of combined sewage, sewer cross sections, inverted siphons, interceptor sewers, flow retarding basins, combined sewage overflows, choice of collecting system. In addition, a cursory review is made of sewage treatment processes, sludge disposal processes, design of sewage treatment works, disposal into receiving waters, disposal onto land, disposal of industrial wastewaters and system management.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Chapter 3 - Wastewater Systems

2. Handout - Schematic Diagrams of Wastewater Collection and Treatment Systems with Basic Terminology

3. Visual Aid - Film "Municipal Sewage Treatment Processes" 13 minutes - Available from Office of Public Health Education, New York State Health Department. Produced by United Word Films, 221 Park Avenue South, New York, New York

LECTURE NO. 6 & 7

NO. OF LECTURE HOURS: 2

Material Covered:

Volume and rate of flow concepts are discussed. Periods of design for the various components of the sewage system are covered. Short and long term forecasts of population growth are reviewed. The use of population data is discussed. Population distributions and density are covered. The makeup of wastewater flows including spent water, infiltration and stormwater runoff are discussed. The variation in flow rates is included as well as a brief discussion of volumes of wastewater in rural systems.

References:

1. "Water and Wastewater Engineering" - Volume 1, Chapter 5 - Water and Wastewater Volumes

2. Handout - Data on Local Wastewater Systems Showing Extreme Overload from Infiltration and Stormwater Intrusion. Would suggest Cheektowaga, West Seneca, and Amherst as possible systems.

LECTURE NO. 8

NO. OF LECTURE HOURS: 1

Material Covered:

Definitions and the scope of hydrology are related to students including a discussion of the water resources of the earth, the different branches of hydrology. The water cycle is covered and methods of data collection and analysis are discussed including rain gaging, snow surveys, stream gaging, groundwater studies. The many types and causes of precipitation in its many forms are covered and methods of measurement. Evaporation and transpiration are covered along with methods of measurement. Percolation of water through soil and its measurement are included. Runoff from varying sources is covered along with methods of measurement and a discussion of use of records of rainfall and runoff.

References:

1. "Water and Wastewater Engineering" - Volume 1, Chapter 6 - Elements of Hydrology

2. Visual Aid - Film "Little Plover River Project, A Study in Sand Plains Hydrology" - 33 minutes 16 mm. sound, color - available from Office of Public Health Education, New York State Health Department. Produced by Wisconsin University Bureau of Visual Instruction, University Extension Division, 1312 West Johnson Street, Madison 6, Wisconsin

LECTURE NO. 9 & 10

NO. OF LECTURE HOURS: 2

Material Covered:

The material presented in these lectures is tied in with Lectures 2, 3, 6, and 7 as a background. Details of design are covered in these two lectures and also in Lectures 11 and 12. The nature of flow is covered here including flow in filled sewers, limiting velocity of flow (transporting velocities and damaging velocities) flow in partially filled sewers, flow in sewer transitions, alternate stages and critical depths, lengths of transitions, transition by hydraulic jump, street inlets and depressed sewers and appurtenant structures.

References:

1. "Water and Wastewater Engineering" - Volume - Chapter 14 - Wastewater Flows

2. Water Pollution Control Federation, Manual of Practice Number 9, "Design and Construction of Sanitary and Storm Sewers." 1969 Water Pollution Control Federation, 3900 Wisconsin Avenue, Washington, D.C. 200

LECTURE NO. 11 & 12

NO. OF LECTURE HOURS: 2

Material Covered:

An evaluation is made of the amount and detail of local information required for the design of sewers. The variations in flow to be handled by sanitary sewers are discussed. The different types of sewers; that is, sanitary sewers, storm drains and combined sewers are discussed. The common elements of sewer profiles are looked at including minimum velocity, minimum sewer depth, distance between manholes, street gradient, sewer gradient, size of sewer and depth of sewer. Capacity design in sanitary sewage work is evaluated as well as layout and hydraulic design in sanitary sewerage.

In addition to the above, capacity design in storm drainage, time of concentration, run-off coefficients, intensity of rainfall, storm pattern analysis, emperical formulations, layout and hydraulic design in storm drainage, hydraulic design of combined sewers, and operation and maintenance of drainage systems are discussed.

A brief look is taken at outfalls into receiving water courses, including fresh water streams, fresh water lakes, and marine outfalls.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Chapter 15 - Wastewater Collection

2. Water Pollution Control Federation, Manual of Practice Number 9 "Design and Construction of Sanitary and Storm Sewers" 1969 - Water Pollution Control Federation, 3900 Wisconsin Avenue, Washington, D.C. 20016

LECTURE NO. 13 & 14

NO. OF LECTURE HOURS: 2

Material Covered:

These lectures will concern themselves with the important components of wastewater collection systems including water and wastewater pumps, the different types of pumps, pump characteristics, cavitation, performance characteristics, air compressors and vacuum pumps, air compression, vacuum pumps, air filters, air piping.

In addition, other components of wastewater systems covered will include wastewater racks and screens, flow meters and regulators.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Chapter 16 - Machinery and Equipment

2. Water Pollution Control Federation, Manual of Practice Number 9, "Design and Construction of Sanitary Sewers", Chapter 7 Appurtenances and Special Structures, 1969 - Water Pollution Control Federation, 3900 Wisconsin Avenue, Washington, D.C. 20016

LECTURE NO. 15

NO. OF LECTURE HOURS: 1

Material Covered:

This lecture will deal briefly with unit operations; that is, objectives and analysis of unit operations which would include gas transfer, ion transfer, chemical coagulation, chemical precipitation, ion exchange, absorption, solute stabilization, solids transfer by straining, sedimentation, flotation and filtration.

It will also include a discussion on nutrient or molecular transfer and interfacial contact. Also included will be a brief discussion of methods of solids concentration ans stabilization. The coordination of unit operations will be discussed with regard to wastewater treatment. In addition, a brief discussion on water renovation or tertiary treatment will be included.

Treatment Kinetics will be covered briefly including the time factor, the rate of treatment response, longitudinal change in treatment response, interfacial contact or transfer opportunity, temperature effects, conjunction kinetics, useful power dissipation, counter-current operation and recirculation.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 21 - Unit Operations and Chapter 22 - Treatment Kinetics

2. Visual Aid - Many films are available on municipal wastewater treatment processes and it is suggested that one or more of these films be used during the discussion of wastewater treatment and disposal.

LECTURE NO. 16

NO. OF LECTURE HOURS: 1

Material Covered:

This lecture will concern itself with aeration and gas transfer. This will include a disucssion of the sources of dissolved gases, the objectives of aeration, a look at different types of aerators including gravity aerators, spray aerators and mechanical aerators. A brief discussion of the factors governing the choice of an aerator will be included. The methods of design for the different types of aerators will be covered.

Various aspects of sedimentation in wastewater treatment will be covered including a discussion of the settling velocities of discrete particles, hindered settling of discrete particles, settling of flocculent suspensions, efficiency of an ideal settling basin. In addition, the size, weight composition in removal of particles will be covered. The reduction in settling efficiency by tank currents will be discussed. In addition short circuiting and basin stability will be looked at. The scour of bottom deposits and improvement of sedimentation by stirring will be covered. The elements of settling tank design will be looked at as well as the general dimensions of these tanks, sludge removal from the tanks inlet hydraulics, outlet hydraulics, common tank loadings and detention periods and tank performance. In addition, sedimentation in good chambers and detritus tanks will be discussed.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 24 - Aeration and Gas Transfer, Chapter 25 - Sedimentation

LECTURE NO. 17

NO. OF LECTURE HOURS: 1

Material Covered:

Flocculation, flotation, and adsorption will be discussed as they relate to wastewater treatment. This discussion will include mixing and stirring devices, gravitational, pneumatic and mechanical. Flocculator loading and performance will be covered. Upflow clarification and its hydraulics will be discussed. Natural flotation, air flotation, air particle contact, flotation reagents, air flotation tanks, skimming tanks, solid liquid adsorption, transfer mechanisms and the use of activated carbon will be discussed. Also included in this lecture will be natural and managed filtration; that is, the use of granular wastewater filters. This discussion will also include granular filtering materials, grain size and size distribution, grain shape and shape variation, preparation of filter sand, hydraulics of filtration, hydraulics of stratified beds.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 26 - Flocculation, Flotation and Adsorption; Chapter 27 - Filtration

LECTURE NO. 18 & 19

NO. OF LECTURE HOURS: 2

Material Covered:

These two lectures deal with the sources of sludge in wastewater treatment including screening, degritting, skimming, and clarification (sedimentation and flotation), methods of sludge thickening (gravity, flotation centrifrigration) are covered as well as sludge blending, sludge digestion (aerobic and anaerobic), sludge elutriation, lagooning and land disposal of liquid sludge. Methods of sludge conditioning and dewatering, composting, use of dried sludge as a fertilizer are discussed. Sludge combustion by various methods, pyrolysis, heat drying and sludge odor control and disinfection are included.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 36 - Waste Solids from Water and Wastewater Treatment.
2. "A Study of Sludge Handling and Disposal", May 1968 by R. S. Burd, Water Pollution Control Research Series Publication Number WP-20-4, U.S. Department of the Interior FWPCA Office of Research and Development

LECTURE NO. 20, 21, 22 & 23

NO. OF LECTURE HOURS: 4

Material Covered:

These four lectures deal with the basics of treatment plant operation and maintenance. The main areas covered will be description of process (review), normal operation, operation and troubles, their causes, prevention and cure.

Treatment processes covered will include sewage pumping and pumping stations, screening, grit removal, sedimentation, sludge digestion, sludge conditioning, sludge dewatering, heat drying and incineration of sludge, sludge disposal, gas collection and utilization, Imhoff Tanks, trickling filters, activated sludge, intermittent sand filters, disinfection and chlorination. Also included is a discussion on the effects of industrial wastes and sewage treatment, a review of methods of keeping records and reports, discussion of basic safety concepts and a review of flow measurement.

References:

1. Water Pollution Control Federation, Manual of Practice Number 11, "Operation of Wastewater Treatment Plants", 1968, WPCF, 3900 Wisconsin Avenue, Washington, D.C. 20016

2. "Manual of Instruction for Sewage Treatment Plant Operators", New York State Health Department, Office of Professional Education

LECTURE NO. 24 & 25

NO. OF LECTURE HOURS: 2

Material Covered:

The ecology and management of receiving watercourses is looked at in these lectures. Patterns of pollution and natural purification as well as the parameters by which they are measured are discussed. Rates of bacterial self-purification, die-away of enteric pathogens, the oxygen economy of polluted waters are included.

Also covered is the kinetics of aerobic decomposition including formulation of the first-stage BOD curve, formulation of the temperature effect and discussions of the limitations of the formula. Deoxygenation of polluted waters, rates of deoxygenation by the suspended and dissolved load, rates of deoxygenation by the benthal load, atmospheric reoxygenation of polluted streams, the dissolved-oxygen sag, allowable BOD loadings of receiving streams, dilution requirements in streams, disposal of wastewater effluents into lakes and the sea.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 33 - Ecology and Management of Receiving Waters

LECTURE NO. 26 & 27

NO. OF LECTURE HOURS: 2

Material Covered:

All aspects of individual household sewage disposal systems are included in these two lectures. Topics covered include site investigation, soil percolation test, subsurface soil analysis, ground water level determination, septic tank design and construction. Component parts of private systems will be looked at including septic tank, distribution box, leaching tiles, seepage pits, subsurface sand filter, tile fields in fill, evaporation - transpiration systems, chlorination. Also covered would be private aerobic treatment plants. The importance of accurate reporting of field surveys and tests is stressed.

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References:

1. "Manual of Septic-Tank Practice" - Public Health Service Publication Number 526 Revised 1967, Superintendent of Documents U.S. Government Printing Office, Washington, D.C. 20201

2. "New York State Health Department Standards for Waste Treatment Works" - Bulletin 1 Part II- Intermediate Waste Treatment Works - Part II - Individual Household Systems

3. "Report on Individual Household Aerobic Sewage Treatment Systems" Publication Number 586 - National Academy of Sciences - National Research Council, 2101 Constitution Avenue N.W., Washington, D.C. 20225

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LECTURE NO. 28 & 29

NO. OF LECTURE HOURS: 2

Material Covered:

Because of the uniqueness of the waste and the increasing use of recreational areas it is judged necessary to offer two lecture hours on collection, treatment, and disposal of wastewater in recreation areas.

These lectures would cover waste from recreation vehicles (campers, trailers, tents) and boats. Also covered would be sewage characteristics in recreational area, waste holding tanks and pump stations for recreation vehicles and boats. Design and operation of small sewage treatment plants would be discussed.

References:

1. "Environmental Health Practice in Recreational Areas" - Public Health Service Publication Number 1195, 1968 U.S. Department of Health, Education and Welfare Public Health Service, National Center for Urban and Industrial Health Environmental Sanitation Program, Cincinnati, Ohio 45202

2. "Environmental Health Practices in Recreational Areas" - Training Course Manual - U.S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Service, Environmental Control Administration, Cincinnati, Ohio 45213, May 1970

LECTURE NO. 30 & 31

NO. OF LECTURE HOURS: 2

Material Covered:

In order to familiarize the student with basic concepts regarding industrial wastewater flows a brief discussion is held on reduction, recovery and reuse of industrial wastewater, collection and treatment, and disposal of these wastes. More specific items such as disposal of wastewater solids are also included. Attention is given to wastewaters with organic and inorganic impurities.

References:

1. "Water and Wastes Engineering" - Volume 2 - Chapter 37 - Industrial Waters and Wastewaters

LECTURE NO. 32

NO. OF LECTURE HOURS: 1

Material Covered:

Basic principles in establishing rules and regulations for water pollution control are discussed. Methods of stream classification are presented. Enforcement procedures are presented. Regulation of industrial discharges through the New York State outfall registration program is covered. Relationship and role of Federal, State and County officials are reviewed.

References:

1. New York State Sanitary Code - Part 73 and Part 75

2. Erie County Sanitary Code - Private Sewage Disposal Regulations

COURSE OUTLINE

A. Course Title and Number: Water Supply, Treatment & Distribution

B. Curriculum Name: Chemical Technology (Environmental Science Option)

C. Number of Class Periods: Three one-hour periods and one three-hour lab session per week for 16 weeks

D. Textbook Used:

E. Prepared By: Anthony T. Voell, Director Environmental Health Services, Chautauqua County Department of Health

G. Objectives: An existing and ever growing shortage of qualified technical personnel in the field of water supply, treatment and distribution accents the need or a concentrated course in the subject area to train for vocations in the environmental health field. The objectives of this course would be the following and would provide an opportunity for prospective environmentalists to:

1. Obtain a general understanding of the concepts of water resources management.
2. Develop ability to understand and interpret engineering reports and plans for water supply and treatment facilities and distribution systems.
3. Acquire basic knowledge of the relation of chemical, physical and bacteriological characteristics of water to its treatment and distribution.
4. Develop understanding of criteria utilized in determining suitability of a body of water (surface or subsurface) as a potential water supply.
5. Obtain working knowledge of unit processes in water treatment, their operation and maintenance.
6. Develop general understanding of factors involved in designing water treatment and distribution systems.
7. Have exposure to water supply systems in recreation areas and private systems.
8. Develop an ability to properly evaluate water supply systems.
9. Acquire general knowledge of existing State and Federal laws governing water supply systems.

LABORATORY SESSION	SUBJECT COVERED
1	Field Trip for Preliminary Observation of Water Treatment Plant, Supply and Distribution System.
2	Class Problem is Assigned for Gathering Basic Information on Population, Water Demands, etc. Preliminary to System Design.
3	Field Trip to Observe Examples of Both Surface and Groundwater Supplies.
4	Laboratory Examination of Samples of Water with Taste and Odor Organisms Present. In Addition, a Guest Lecturer Could be Utilized to Discuss the Taste and Odor Problem.
5	Field Trip to Observe Specifically Methods of Sedimentation and Coagulation in Water Treatment. Class Problem Assigned to Develop Data for Sedimentation and Coagulation Unit Operations. Information of Flows and Water Quality Given.
6	Field Trip to Observe Various Methods of Water Filtration Including Mixed Media, Sand and Diatomaceous Earth.
7	Guest Lecturer on Chlorine Safety and Use in Water Treatment Plants.
8	Field Trip to Observe Various Special Treatment Methods for Water Used in Industry, Flouridation, Corrosion Control, etc.
9	Guest Lecturer on Laboratory Examinations at Water Treatment Plants and Visit to Water Plant Laboratory to Observe Operations.
10	Class Problem on Sizing of Pumps for Water Systems - Low Lift, High Lift and Booster Pumps.
11	Guest Lecturer on the Use of Computer Programs in the Design of Water Distribution Systems.
12	Guest Lecturer on Safety and Emergency Procedures Relative to Water Works.
13	Field Exercise on the Evaluation of Operation and Maintenance of Water Supply Systems.

LABORATORY SESSION	SUBJECT COVERED
14	Field Exercise on the Evaluation of Operation and Maintenance of Water Supply Systems.
15	Field Exercise on Evaluation of Private Water Supply Systems and Systems in Recreational Areas.
16	Guest Lecturer on Role of Agencies in Water Treatment.

LECTURE NUMBER	SUBJECT MATERIAL COVERED
1	Orientation to Course
2	Water Resources and Conservation
3	Water Resources and Conservation
4	Water Volumes
5	Water Volumes
6	Ground Water Supplies and Collection
7	Ground Water Supplies and Collection
8	Surface Water Supplies and Collection
9	Surface Water Supplies and Collection
10	Taste and Odors in Surface Water Supplies
11	Taste and Odors in Surface Water Supplies
12	Taste and Odors in Surface Water Supplies
13	Water Chemistry
14	Water Chemistry
15	Water Chemistry
16	Pretreatment of Water
17	Coagulation and Sedimentation
18	Coagulation and Sedimentation
19	Filtration
20	Filtration
21	Disinfection of Water
22	Disinfection of Water
23	Special Treatment
24	Special Treatment
25	Laboratory Examinations and Interpretation
26	Laboratory Examinations and Interpretation
27	Pumps and Measurement of Pumps
28	Pumps and Measurement of Pumps
29	Instrumentation
30	Distribution System
31	Distribution System
32	Customer Meters
33	Water System Safety
34	Water System Safety
35	Emergency Operations
36	Water System Operation and Maintenance Evaluation Methods
37	Water System Operation and Maintenance Evaluation Methods
38	Water System Operation and Maintenance Evaluation Methods

LECTURE NUMBER	SUBJECT MATERIAL COVERED
39	Private Water Systems
40	Private Water Systems
41	Water Systems for Recreation Areas
42	Water Systems for Recreation Areas
43	Water Quality Objectives
44	Water Quality Objectives
45	Role of Public Agencies
46	Role of Public Agencies
47	Storage of Treated Water
48	Storage of Treated Water

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LECTURE NO. 1

NO. OF LECTURE HOURS: 1

Material Covered:

The first lecture is to orient the students the objectives of the course. The course outline is briefly explained and handed out. The use of laboratories and their relationship to the lecture periods is explained. The textbook(s) to be used are presented.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Water Supply and Wastewater Disposal
   Volume 2 - Water Purification and Wastewater Treatment & Disposal
   Gordon Maskew Fair, John Charles Geyer, Daniel Alexander Okum - Copyright 1968,
   John Wiley & Sons, Inc., New York

2. "Manual of Water Utility Operations" - Copyright 1969, Texas Water Utilities Association, Printed by Lancaster Press, Inc., Lancaster, Pennsylvania

3. "Manual of Instruction for Water Treatment Plant Operators" - New York State Department of Health - Office of Public Health Education

LECTURE NO. 2 & 3

NO. OF LECTURE HOURS: 2

Material Covered:

The primary factors of resource development are covered including rainfall, stream flow, evaporation, siltation and water quality. Different aspects of using surface water as a source of supply are looked at including continuous draft of water, selective draft and impoundage. A general discussion is held regarding groundwater sources. Springs, wells, infiltration galleries and recharging devices are covered briefly.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Water Supply and Wastewater Removal, Chapter 2 - Water Systems

2. "Manual of Water Utility Operations" - Chapter 1 - Water Resources and Conservation

3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 2 - Water Sources and Water Uses

4. Visual Aid - Film - "Finding Out About the Water Cycle", 16 mm color - 13.5 minutes - Office of Public Health Education, New York State Health Department, 84 Holland Avenue, Albany. United World Films, 221 Park Avenue South, New York, New York

LECTURE NO. 4 & 5

NO. OF LECTURE HOURS: 2

Material Covered:

Volume and rate of flow concepts are looked at with regard to water systems. The lengths of design periods for component structures of a water system are covered. Population data and growth and the use of long and short term forecasts is discussed. Water consumption variations are discussed and the factors affecting consumption are also covered. Variations in water demand are looked at including normal variation, fire demand and coincident draft.

References:

1. "Water and Wastewater Engineering" - Chapter 5 - Water and Wastewater Volumes
2. "Manual of Instruction for Water Treatment Plant Operator" - Chapter 2 - Water Sources and Water Uses

LECTURE NO. 6 & 7

NO. OF LECTURE HOURS: 2

Material Covered:

A general look is taken at groundwater supplies and collection. The concepts of water table and artesian supplies is discussed. An explanation of well construction including dug wells, driven and jetted wells, bored wells and drilled wells is included. Gravel-wall and collector wells are discussed as well as the use of cementing and sealing and well strainers.

A brief discussion on pumping equipment, well development and testing and interference of wells. Consideratio is given to the factors affecting the yield of wells.

Sanitary precautions in well construction are stressed as well as the operation and maintenance of wells.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Chapter 9 - Groundwater Flow, Chapter 10 - Groundwater Collection

2. "Manual of Water Utility Operations" - Chapter 2 - Groundwater Supplies

3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 2 - Water Sources and Water Uses

LECTURE NO. 8 & 9

NO. OF LECTURE HOURS: 2

Material Covered:

The following subject areas would be covered in these lectures. Catchment areas (upland and lowland areas) and quality control of these areas; reservoir siting, site preparation (initial stabilization rates and site clearance), reservoir management (quality control, evaporation control); types of dams and dikes (embankment dams, masonry dams) and some design characteristics; spillways, intakes and water diversion works.

Sanitary protection of surface water sources is also included as well as operation and maintenance of catchment areas, reservoirs, etc.

References:

1. "Water and Wastewater Engineering" - Volume 1 - Chapter 11 - Surface Water Collection

2. "Manual of Water Utility Operations" - Chapter 3 - Surface Water Supplies

3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 2 - Water Sources and Water Uses

LECTURE NO. 10, 11 & 12

NO. OF LECTURE HOURS: 3

Material Covered:

Sources of taste and odor are discussed including various types of micro-organisms which produce taste and odor compounds, industrial wastes and other miscellaneous sources. Methods of controlling micro-organisms and treating water for taste and odor problems are discussed.

References:

1. "Manual of Water Utility Operations" - Chapter 5 - Tastes and Odors in Surface Water Supplies
2. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 14 - Taste and Odor Control

LECTURE NO. 13, 14 & 15

NO. OF LECTURE HOURS: 3

Material Covered:

The purpose of these lectures will be to review certain terminology, chemical principles and mathematical considerations involved in water treatment. Concepts of matter, energy are covered. Structure of matter, symbols, formulas, equations, the nature of gases and solutions and suspensions are also included.

Other subjects covered include ionization, chemical equilibrium, hydrates, the normal system, hydrogen ion concentration (pH), acids, bases, salts, acidity and alkalinity, colloids and coagulation.

References:

1. "Manual of Water Utility Operations" - Chapter 6 - Water Chemistry

2. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 4 - Water Chemistry

LECTURE NO. 16

NO. OF LECTURE HOURS: 1

Material Covered:

These lectures present a discussion on the different methods of pre-treatment of water and the reasons which require this pre-treatment.

References:

1. "Manual of Water Utility Operations" - Chapter 7 - Pre-Treatment of Water

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LECTURE NO. 17 & 18

NO. OF LECTURE HOURS: 2

Material Covered:

These lectures will deal with the specific processes of coagulation and sedimentation in water treatment. Also included in this discussion will be a review of coagulating chemicals and the mechanism of coagulation, physical facilities used for coagulation, and the control of coagulation.

In addition, the process of sedimentation will be investigated.including a look at the settling velocities of discrete particles, hindered settling of discrete particles, settling of flocculent suspensions, efficiency of an ideal settling basin, reduction in settling efficiency by currents, short circuiting and basin stability, scour of bottom deposits, and improvement in sedimentation by stirring.

A brief look will be taken at the elements of settling tank design and the general dimensions of settling tanks as well as sludge removal, inlet and outlet hydraulics, common tank loadings and detention periods and tank performance.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 25 - Sedimentation

2. "Manual of Water Utility Operations" - Chapter 8 - Coagulation and Sedimentation

3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 6 - Water Quality

LECTURE NO. 19 & 20

NO. OF LECTURE HOURS: 2

Material Covered:

A brief history of the use of filtration in water treatment is presented. Different aspects of rapid sand filters are covered including the physical arrangement, production system, filter material, barrier medium, under drain system, and effluent piping. The filter cleaning media is also discussed including the dispersion medium, wash water troughs, sewer piping, surface wash and method for washing filters.

Also covered in these lectures is the filter control and instrument system, mixed bed filters, diatomite filters and pressure filters.

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References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 27 - Filtration

2. "Manual of Water Utility Operations" - Chapter 9 - Filtration

3. "Manual of Instruction for Water Treatment Operators" - Chapter 9 - Filtration

LECTURE NO. 21 & 22

NO. OF LECTURE HOURS: 1

Material Covered:

This lecture will cover the disinfection process and different types of disinfectants. Disinfection by heat, light, and chemical disinfectants will be covered in these discussions. The theory of chemical disinfection will be briefly discussed as well as the kinetics of chemical disinfection. Disinfection by the use of chlorine compounds will be covered extensively because of the wide use of this chemical in water treatment.

References:

1. "Water and Wastewater Engineering" - Volume 2 - Chapter 31 - Disinfection
2. "Manual of Water Utility Operations" - Chapter 10 - Disinfection of Water
3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 10 - Chlorination

LECTURE NO. 23 & 25

NO. OF LECTURE HOURS: 2

Material Covered:

Methods of special treatment for water supplies are covered in these lectures. A discussion of the causes of hard water and the process of water softening is included. Also included are methods of iron and manganese removal, removal of dissolved gases, removal of color, floridation of public water supplies, corrosion control, treatment of boiler feedwater, process water, and other miscellaneous water treatment for industrial uses. A brief discussion is held on treatment of waters containing radioactive materials.

References:

1. "Manual of Water Utility Operations" - Chapter 11 - Special Treatment

2. "Manual of Instruction for Water Treatment Plant Operators"
   Chapter 11 - Softening
   Chapter 12 - Aeration
   Chapter 13 - Iron and Manganese
   Chapter 15 - Corrosion and Corrosion Control
   Chapter 16 - Floridation

LECTURE NO. 25 & 26

NO. OF LECTURE HOURS: 2

Material Covered:

Brief discussions are held on the types of laboratory examinations performed at water treatment plants. Material covered will include:

sample collection
sampling methods
storage of samples

Also covered will be:

glassware preparation
media preparation
different types of culture media

Brief exposure will be given to tests for members of the coliform group as well as methods for measuring the density of coliform groups. Analysis for fecal streptococcal group will also be included.

Physical tests which will be reviewed briefly will include color, filter sand characteristics, pH, tests for tastes and odors, temperature, and turbidity.

Chemical tests which will be reviewed will include alkalinity, acidity, chlorides, chlorine residual, florides, total hardness, and sulfates.

References:

1. "Manual of Water Utility Operations" - Chapter 12 - Laboratory Examinations
2. "Water and Wastewater Engineering" - Volume 2 - Chapter 20 - Examination of Water and Wastewater
3. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 21 - Laboratory Examinations

LECTURE NO. 27 & 28

NO. OF LECTURE HOURS: 2

Material Covered:

An introduction is given to pumps and measurement of pumps in these lectures. The factors affecting pump selection are discussed as well as pump nomenclature. Fundamental terms regarding pumps are discussed.

Power sources for supplying power to pumps are covered in these lectures as well as variable speed drives, motor starters, and deep well turbine pumps.

References:

1. "Manual of Water Utility Operations" - Chapter 13 - Pumps and Measurements of Pumps

2. "Water and Wastewater Engineering" - Volume 1 - Chapter 16 - Machinery and Equipment

LECTURE NO. 29

NO. OF LECTURE HOURS: 1

Material Covered:

Different types of instrumentation used in water supply collection and treatment are discussed in this lecture. This is concerned primarily with telemetering. The advantages and initial costs of telemetering are discussed as well as the operation and maintenance of the system.

References:

1. "Manual of Water Utility Operations" - Chapter 14 - Instrumentation

LECTURES NO. 30 & 31

NO. OF LECTURE HOURS: 2

Material Covered:

Discussion is held in these lectures on the water distribution system. The design of the distribution system including planning population, fire requirements, main sizes and other considerations are covered. The sizing of service lines, the location of line valves, location of fire hydrants and special valves and the use of booster stations and tanks are discussed in these lectures.

Brief discussion is held on the construction of the distribution system including the types of materials and installation of lines and services. Also included are the important aspects of disinfection and bacteriological testing of new distribution systems.

The operation of the distribution system is also covered, including keeping of maps and records, cleaning and flushing of mains, accounting for water, and other aspects of the operation of the system.

The maintenance of the distribution system is covered briefly including repairing main breaks, joint breaks, broken service lines, maintenance of valves.

References:

1. "Manual of Water Utility Operations" - Chapter 15 - Distribution System
2. "Water and Wastewater Engineering" - Volume 1 - Chapter 13 - Water Distribution

LECTURE NO. 32

NO. OF LECTURE HOURS: 1

Material Covered:

Because of the wide use of water meters for customer services, it is found necessary to have one lecture on the subject of customer meters.

This lecture would discuss the types of meters in use and also look into the selection of meters and the repair and replacement of these installations.

Brief discussion is held on the field installation and testing of meters and the expected length of service. Also included is the keeping of records, the care and protection of meters, and suggested shop equipment for maintenance of customer meters.

References:

1. "Manual of Water Utility Operations" - Chapter 17 - Customer Meters

LECTURE NO. 33 & 34

NO. OF LECTURE HOURS: 3

Material Covered:

These two lectures will deal with the subject of safety in water treatment works. The subjects will include discussions of the responsibilities for safety, development of a safety program, maintenance of safety records (statistics and reports), safety education-training, employee equipment, public safety equipment, fleet safety.

In addition, certain types of accident areas will be covered, including falls, electric shock, infections, asphyxiation, explosions, toxic dusts, dangerous chemicals, and inadequate help.

In addition, instruction will be given on procedures to follow in case of an accident, including resuscitation, clearing victim's throat, and safety with chlorine.

The necessity for planning any addition or new construction so that safety features can be built-in, will be emphasized.

References:

1. "Manual of Water Utility Operations" - Chapter 21 - Safety
2. "Manual of Instruction for Water Treatment Plant Operators" - Chapter 19 - Treatment Plant Maintenance and Accident Prevention

LECTURE NO. 35

NO. OF LECTURE HOURS: 1

Material Covered:

Brief discussions will be held in this lecture on types of emergencies which may be encountered in water treatment works and measures which may be taken to handle water treatment during emergency conditions. Brief discussions will be held concerning emergency plans, personnel, equipment and supplies, communications. Also included will be discussions of emergency water supplies which may be utilized during these situations and methods for disinfection of emergency water systems.

References:

1. "Manual of Water Utility Operations" - Chapter 23 - Emergency Operation

LECTURE NO. 36, 37, & 38

NO. OF LECTURE HOURS: 3

Material Covered:

These lectures will deal with the methodology for evaluating the operation and maintenance of water supply treatment and distribution systems.

The lectures will cover three main areas:

(1) Sanitary survey and water treatment requirements

(2) Recommended sanitary requirements for water source protection and treatment

(3) Recommended sanitary requirements for water distribution systems

References:

1. "Manual for Evaluating Public Drinking Water Supplies" - U.S. Department of Health Education and Welfare Public Health Service, Consumer Protection and Evnironmental Health Service, Environmental Control Administration Bureau of Water Hygiene, Cincinnati, Ohio 45202 (1969) Public Health Service Publication No. 1820

LECTURE NO. 39 & 40

NO. OF LECTURE HOURS: 2

Material Covered:

These lectures will deal with the subject of private water supply systems because of the large number of individual water supplies still being developed. It is felt essential that environmental technician personnel be fully acquainted with all aspects of private water supply installation and evaluation.

These lectures will deal with the following areas:

(1) Selection of a water source including different sources of water supply, quality of water, quantity of water, and sanitary survey.

(2) The use of ground water as a private water supply including discussions on rock formations and their water bearing properties, ground water basins, sanitary quality of ground water, distances to sources of contaminations, development of ground water by the various methods and the details of well construction.

(3) The use of surface water for rural water supply will be considered including control of pollution on ponds or lakes, streams and irrigation canals.

(4) A discussion will be held concerning water treatment for individual water supplies. This will deal with all aspects of private water supply treatment.

(5) Pumping, distribution, and storage of water for individual water supplies will be covered.

References:

1. "Manual of Individual Water Supply Systems" - Public Health Service Publication No. 24 (Revised 1962), U.S. Department of Health Education and Welfare, Division of Environmental Engineering and Food Protection, Special Engineering Services Branch, Washington 25, D.C.

2. "Rural Water Supply" - (1966) - New York State Department of Health, Office of Public Health Education

3. Suggested Visual Aide - Film - "Safe Drinking Water from Small Water Supplies" - 16 mm. sound 11 minutes - University of Minnesota, Visual Education Services, Minneapolis, Minnesota

LECTURE NO. 41 & 42

NO. OF LECTURE HOURS: 2

Material Covered:

The increasing use of recreation areas has developed a need for environmental technician personnel to be fully acquainted with semi-public water systems serving recreational areas.

These lectures will deal with the unique problems encountered in developing water systems to serve recreation areas with highly fluctuating populations and isolated areas.

The need for treatment will be discussed as well as treatment methods which may be utilized for recreation areas. Typical treatment systems which are suitable for rural locations and handling highly fluctuating demands will be discussed. Design considerations for small water systems will be covered and a look will be taken at certain package treatment plants which have been utilized for this purpose. The operation of small water treatment plants will also be discussed.

References:

1. "Environmental Health Practices in Recreational Areas" - Training Course Manual, U.S. Department of Health Education and Welfare, Public Health Service, Consumer Protection and Environmental Health Service, Environmental Control Administration, Cincinnati, Ohio 45213 (May 1970)

2. "Environmental Health Practice in Recreation Areas" - Public Health Service Publication Number 95, U.S. Department of Health Education and Welfare, Public Service, Environmental Sanitation Program, Cincinnati, Ohio 45202

LECTURES NO. 43 & 44

NO. OF LECTURE HOURS: 2

Material Covered:

These two lectures will deal with an explanation of the objectives strived for in water quality management. Included in them is a description of natural waters, drinking water, types of bacterial and other water born infections encountered, reduction of infections by water quality management, water born poisons, and other health-associated properties of water.

Also included in these discussions will be the palatability of water, drinking water standards, bathing waters, fishing waters, shellfish and irrigation waters. In addition, a brief look will be taken at receiving waters which would accept wastewater treatment effluents and the relationship of treatment works to water quality standards.

References:

1. "Water & Wastewater Engineering" - Volume 2 - Chapter 19 - Water Quality Objectives

LECTURE NO. 45 & 46

NO. OF LECTURE HOURS: 2

Material Covered:

These lectures will discuss the role of public agencies in water utility operations. Included will be international agencies, federal agencies, state agencies, and miscellaneous and unofficial agencies.

References:

No specific references are offered for these lectures. However, it is suggested that the instructor obtain numerous publications concerning public, semi-public, and private agencies in New York State and publications concerning federal and national agencies.

LECTURE NO. 47 & 48

NO. OF LECTURE HOURS: 2

Material Covered:

These lectures will deal with the storage of treated water. Included will be ground storage, elevated tanks and their design, domestic storage requirements, fire storage requirements, emergency storage requirements, and total storage requirements.

Also included will be brief discussions concerning pump capacity and location of distribution reservoirs, sanitary requirements, and tank construction of storage reservoirs, reinforced concrete tanks, and steel tanks as well as ground storage tanks. Also included will be stand pipes and elevated tanks. The maintenance of storage tanks will be discussed with specific reference to cathodic protection.

References:

1. "Manual of Water Utility Operations" - Chapter 16 - Storage of Treated Water

2. "Water and Wastewater Engineering" - Volume 1 - Chapter 13 - Water Distribution

COURSE OUTLINE

A. **Course Title and Number:** Instrumentation (Environmental)

B. **Curriculum Name:** Chemical Technology

C. **Number of Class Periods:** Three lecture hours and one 3-hour lab per week for 16 weeks

D. **Textbook Used:** Instrumentation by Kirk and Rimboi, Published by American Technical Society, Chicago, Illinois 60637

E. **Prepared By:** C. R. Wild, Air Pollution Control, Erie County Health Department

F. **Objectives:** To cover the fundamental principles involved in instrumentation and become familiar with their application in specific equipment through study and operation during laboratory sessions.

NO. OF LECTURE PERIODS	MAIN TOPICS
2	Introduction: Industrial Instrumentation Recorders and Monitors Panel Boards Characteristics of Instruments Static Characteristics Dynamic Characteristics
2	Temperature: Heat Transfer Temperature Scales Thermometers Mercury Bimettalic Pressure Spring Resistance Thermocouples Pyrometers

NO. OF LECTURE PERIODS	MAIN TOPICS
2	Pressure: Manometers Pressure Elements Differential Pressure
2	Level: Direct Liquid Level Measurement Bob and Tape Sight Glass Floats Indirect Liquid Level Measurement
3	Flow: Rate of Flow Meters Differential Pressure Variable Area Total Flow Meters Positive Displacement Velocity Integrators
2	Humidity: Absolute Humidity Relative Humidity Dew Point Measuring Moisture
1	Transmission: Pneumatic Electric Time Impulse

NO. OF LECTURE PERIODS	MAIN TOPICS
3	Control:
	Control Elements
	Control Actions
	Pneumatic Control Systems
	Electric Control Systems
	Final Elements
4	Electricity:
	Direct Current
	Series and Parallel Circuits
	Networks
	Inductance
	Capacitance
	Alternating Current
	Inductive Reactance
	Capacitative Reactance
	Impedance
	Electronics
	Vacuum Tube
	Transistors
4	Temperature:
	Temperature Measurement - Mechanical
	Temperature Measurement - Electrical
3	Pressure:
	Manometers
	Elastic Deformation Elements
	Pressure Transducers

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NO. OF LECTURE PERIODS	MAIN TOPICS
3	Flow: Viscosity Nozzles Plates Rotameters Mass Flow Measurement
3	Analysis: Density and Specific Gravity Viscosity Acidity and Alkalinity Conductivity Chromatography
6	Control: Step Function Response Proportional Adjustable Controllers Pneumatic Electric Hydraulic Valves
8	Application: Temperature Pressure Level Control Flow Control Analysis Control Specific Pollution Equipment Air Hi Volume Samplers Continuous Monitoring Devices Water Continuous Monitoring Devices

INSTRUMENTATION (ENVIRONMENTAL)

These sessions should closely parallel the major lecture topics. Where possible, items of equipment directly used in Air and Water Pollution work should be used.

In the more advanced sessions, because of time limitations, demonstrations may be necessary and preferable to enable better coverage of the equipment being considered.

The specific experiments or tests to be integrated into each session will be left to the instructor and will relate to the equipment on hand as well as other factors.

LABORATORY SESSIONS	TOPICS
1	Temperature
2	Pressure
3	Level
4	Flow
5	Humidity
6	Transmission
7	Control
8	Electricity - D.C.
9	Electricity - A.C.
10	Temperature
11	Pressure
12	Flow
13	Analysis
14	Control (Include Application)
15	Tour Local Air and Water Pollution Laboratories
16	Summary and Clean-Up

COURSE OUTLINE

A. Course Title and Number: Air Resources I

B. Curriculum Name: Chemical Technology

C. Number of Class Periods: Three lecture hours, one 3-hour lab per week for 16 weeks

D. Textbook Used: Instructor's Option (See References)

E. Prepared By: C. R. Wilde, Air Pollution Control, Erie County Health Department

F. Objectives: This introductory course encompasses the overall view of the air pollution problem starting with a review of past episodes such as London, England and Donora, Pennsylvania through Air Resource Management which includes among other topics a discussion of air quality criteria and standards. It also stresses the legal aspects of air pollution control. Finally, the laboratory sessions liberally incorporate field trips through various large pollution sources to reinforce the classroom experience.

NO. OF LECTURE PERIODS	MAIN TOPICS
4	INTRODUCTION AND HISTORY
	Review of Past Episodes Meuss Valley, Belgium London, England Donora, Pennsylvania New York City - Thanksgiving Day
	Current Public Concern
	Common Pollutants Sulfur Oxides Particulates Carbon Monoxide Hydrocarbons

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AIR RESOURCES I

LABORATORY SESSIONS	TOPICS
2	Hi Volume Filter Processing Dustfall Jar and Sulfur Candle Processing
1	Microscopic Examination of Pollutants
2	Ringelmann Training Known Source Field Observations
7	Field Visits (Process Industries - 1 each) Steel Mill (Bethlehem or Republic) Grain Industry (General Mills, International Multifoods, Inc.) Rendering (Darling & Company or Kraus and Ball Company) Chemical Plant (Allied) Foundry (Worthington or American Standard) Coke Oven (Semet Solvay or Donner Hanna) Refinery (Ashland Oil or Mobil Oil Corporation)
2	Auto Exhaust Workshop Local Rule & Orientation (County Air Pollution Agencies) Field Observations (with qualified inspectors)
1	Visit to Local Control Agency
1	Summary and Lab Clean-Up

NO. OF LECTURE PERIODS	MAIN TOPICS	
	References:	
	"Elements of Air Quality Management"	U.S. Department of Health, Education and Welfare National Air Pollution Control Administration 411 W. Chapel Hill Street Durham, North Carolina 27701
4	SOURCES OF AIR POLLUTION Classification of Sources of Emission Classification and Definition of Air Pollutants Formation of Secondary Pollutants	
	References:	
	"Elements of Air Quality Management"	U.S. Department of Health, Education and Welfare Durham, North Carolina
	"Gaseous Atmospheric Pollutants from Urban and Natural Sources" .	Robinson and Robbins, Stanford Research Institute Menlo Park, California 94025
8	EFFECTS OF AIR POLLUTION Target Organ Protective Mechanisms Effects on Man Effects on Animals Effects on Vegetation Effects of Air Pollution on Materials Effects on Atmospheric Visibility	

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NO. OF LECTURE PERIODS	MAIN TOPICS	
	References:	
	"Elements of Air Quality Management"	U.S. Department Health, Education and Welfare Durham, North Carolina
14	AIR RESOURCE MANAGEMENT	
	Source Inventory Emission Factors Meteorology Environmental Ratings Abatement Schedules Air Quality Criteria Air Quality Standards Emission Standards and Code Preparation	
	References:	
	"Elements of Air Quality Management"	U.S. Department of Health, Education and Welfare Durham, North Carolina
	"Atmospheric Survey and Studies"	U.S. Department of Health, Education and Welfare Durham, North Carolina
	"A Compilation of Air Pollutant Emission - Factors for Combustion Products, Gasoline Evaporation and Selected Industrial Processes	U.S. Department of Health, Education and Welfare Durham, North Carolina
	"Air Quality Criteria" - Documents	U.S. Department of Health, Education and Welfare Durham, North Carolina

NO. OF LECTURE PERIODS	MAIN TOPICS
16	LEGAL ASPECTS OF AIR POLLUTION CONTROL History Common Law Statute Law Civil and Criminal Law Administrative Hearings (Quasi Judicial) Judicial Actions Injunctions Law and Equity Nuisance Role and Conduct of a Witness Right of Inspection Proper Documentation of Violations

References:

"The Law in Relation to Public Health"	Department of Health, Education and Welfare Communicable Disease Center Atlanta, Georgia
"Legal Aspects of Air Pollution Control"	U.S. Department of Health, Education and Welfare Durham, North Carolina
"Law and Contemporary Problems - Air Pollution Control"	School of Law Duke University Spring 1968
"The Conduct of Public Health Administrative Hearings and the Prevention of Evidence at Such Hearings"	Emanuel Bund Columbia University School of Public Health and Administrative Medicine

NO. OF LECTURE PERIODS	MAIN TOPICS	
	"Fifty Years of Air Pollution Law"	Harold W. Kennedy Paper 57-52, A.P.C.A., Meeting 1957 A.P.C.A., 4400 Fifth Avenue Pittsburg, Pennsylvania
	"Legal Aspects of Air Pollution"	Procedings of Rutgers Seminar School of Law, Rutgers The State University Newark, New Jersey
	"The Role of a Witness" - Movie	Available on loan through N.A.P.C.A., Durham, North Carolina

2 PUBLIC RELATIONS AND COMMUNITY SUPPORT

Nature
Various Publics
Need
Channels of Communication

References:

"Elements of Air Quality Management:	U.S. Department Health, Education and Welfare Durham, North Carolina

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COURSE OUTLINE

A. Course Title and Number: Air Resources II

B. Curriculum Name: Chemical Technology

C. Number of Class Periods: Three lecture hours, one 3-hour lab per week for 16 weeks

D. Textbook Used: Instructor's Option (See References)

E. Prepared By: C. R. Wilde, Air Pollution Control, Erie County Health Department

F. Objectives: This course concentrates primarily on the technological aspects of air pollution control, covering in detail design and operation of common air pollution sources such as various types of boilers and incinerators. Also included is a rundown of the basic pollution control devices commonly encountered. The laboratory sessions, as in Air Resources I, rely heavily on field trips to major sources of pollution to reinforce the classroom discussions.

NO. OF LECTURE PERIODS	MAIN TOPICS
12	AIR POLLUTION EQUIPMENT Boilers - Coal, Oil and Gas Design, Types and Operation Incinerators - Design and Operation Municipal Units Package Types Apartment Types Special Industrial Destructors Internal Combustion Engines Automobile Buses Trucks Locomotives Aircraft

AIR RESOURCES II

LABORATORY SESSIONS	TOPICS
4	Field Visits (Incineration): Municipal Incinerators Apartment Incinerators Package Type Units Hospital Units (Including Destructors)
4	Field Visits (Boilers): Gas Fired Oil Fired Coal Fired Power Generation - Huntley Station, Niagara Mohawk Power
2	Documentation and Investigation of Air Pollution Sources
4	Stack Sampling: Equipment Testing Preparation Actual Testing Calculation of Results
1	Visit to Local Control Agency
1	Summary and Lab Clean-Up

NO. OF LECTURE PERIODS	MAIN TOPICS	
	References:	
	"A Compilation of Air Pollutant Emission Factors for Combustion Processes, Gasoline Evaporation and Selected Industrial Processes"	U.S. Department Health, Education and Welfare Durham, North Carolina
	"Fundamentals of Smoke Abatement"	J. F. Barkley, Bureau of Mines Information Circular 7588, U. S. Department of Interior
	"Air Pollution Around J. F. Kennedy International Airport"	U. S. Department of Health, Education and Welfare Durham, North Carolina
	"Bunkie's Guide to Fuel Oil Specifications"	National Oil Fuel Institute Bulletin 68-101 60 E. 42nd Street New York City, New York 10017
	"Air Pollution Control - A Workbook for Operators of Residual Oil Burning Equipment and Incinerators"	Department of Air Resources New York City, New York
	"Criteria Used for Upgrading Existing Apartment House Incincerators in the City of New York	Department of Air Resources New York City, New York
	"Municipal Incineration"	M. H. Detrick Company 20 N. Wacker Drive Chicago, Illinois 60606 Bulletin D-61
	"Air Pollution from Motor Vehicles"	Ralph I. Larsen U.S. Department Health, Education and Welfare Durham, North Carolina

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NO. OF LECTURE PERIODS	MAIN TOPICS
14	TECHNOLOGY OF AIR POLLUTION CONTROL

Approaches to Control

Raw Material or Process Change

Control of Particulate Emissions
- Dry Inertial Separators
- Wet Collectors
- Electrostatic and Fabric Collectors

Control of Vapors and Gases
- Combustion
- Absorption
- Adsorption
- Closed Systems
- Masking and Counteraction

References:

"Elements of Air Quality Management"	U.S. Department Health, Education and Welfare Durham, North Carolina
"Air Pollution - Control, Regulational Equipment" - Reprint July 23, 1962	Chemical Engineering News McGraw-Hill Publishers 330 W. 42nd Street New York, New York
"Arc Furnace Fume Control"	American Air Filter Company A.P.C.A. Paper 68-131

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NO. OF LECTURE PERIODS	MAIN TOPICS
20	ATMOSPHERIC SAMPLING AND ANALYSIS

Air Sampling Site Selection

Principles of Absorption

Principles of Adsorption

Principles of Grab Sampling

Gaseous Pollutants

Sampling for Particulates

Sampling for Gaseous Pollutants

Inertial and Precipitator Sampling

Automatic Sampling Devices

Analysis of Samples
- Analytical Procedures
- Hi Volume Filters
- Microscopic
- Airborne Allergens

Stack Sampling
- Equipment Used
- Procedures

References:

"Elements of Air Quality Management" — U.S. Department Health, Education and Welfare, Durham, North Carolina

"Atmospheric Survey and Studies" — U.S. Department Health, Education and Welfare, Durham, North Carolina

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NO. OF LECTURE PERIODS	MAIN TOPICS	
	"Incinerator Testing, Bulletin T-6"	Incinerator Institute of America 60 E. 42nd Street New York, New York 10017
	"Air Pollution Control Field Cperations Manual"	U.S. Department Health, Education, and Welfare Durham, North Carolina
2	ODOR CONTROL Types of Odors Measurements Control Available Surveys	
	References:	
	"Odors - Results of Surveys"	June 1966 Interstate Air Pollution Survey U.S. Department Health, Education and Welfare Durham, North Carolina

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THE BACCALAUREATE PROGRAM IN ENVIRONMENTAL SCIENCES TECHNOLOGY

This program was developed at the State University College at Buffalo by the Director of the Great Lakes Laboratory. Its main purpose is to enable Community College graduates who have majored in Environmental Science to continue to specialize in the Environmental Sciences upon admission to the Baccalaureate Arts program in Biology or Chemistry. It is consistant with the mandate that the State University Colleges of Arts and Sciences increase their enrollment at the upper division level and train more pollution specialists. Presently there is no similar program located anywhere in the State University system. Discussions have been held with the directors of the two-year schools to modify their existing programs to minimize the loss of credit and the necessity to make up lower division required courses for those students who transfer into the baccalaureate program. The Environmental Science Technology program will be open to any student at Buffalo State as long as he meets the requirements. However, in order to graduate with a BA in Biology or Chemistry, with a specialization in the Environmental Sciences, he would have to complete the certain prerequisite technical courses in Environmental Health. It will be possible for students at Buffalo State to take these prerequisite courses in the Environmental Sciences program at Erie Community College. The curricula of the Environmental Science program at the State University consists of the following:

The transferable credit of an individual who would major in Biology at Buffalo State would be as follows:

General Biology	6 credits
Microbiology	3 credits
Biology Electives	6 credits
General Chemistry	6 credits
Quantitative Analysis	3 credits
Qualitative Analysis	3 credits
Instrumental Analysis	3 credits
General Physics	6 credits
English	6 credits
Mathematics	6 credits
Physical Education	2 credits
Unrestricted Electives	10 credits
TOTAL	60 credits

The Biology major specializing in Environmental Sciences would take the following program to complete his baccalaureate:

Genetics	4 credits
Physiology	4 credits
Ecology	4 credits
Biology Electives	6 credits
Breadth (Arts, Social Science, Math and Science, and Humanities)	38 credits
Environmental Measurement	3 credits
Applications of Environmental Technology	3 credits
Seminar in Environmental Sciences	2 credits
Physical Education	2 credits
Subtotal	64 credits
Transferred	60 credits
TOTAL	124 credits

For a potential Chemistry major, his background most likely would include:

General Chemistry	6 credits
Instrumental Analysis	3 credits
Qualitative Analysis	3 credits
Quantitative Analysis	3 credits
Organic Analysis	6 credits
Microbiology	3 credits
Physics	6 credits
Mathematics (Calculus)	6 credits
English	6 credits
Physical Education	2 credits
Unrestricted Electives	16 credits
TOTAL	60 credits

The Chemistry major specializing in Environmental Sciences would take the following program to complete his baccalaureate:

Physical Chemistry	8 credits
Literature of Chemistry	1 credit
Inorganic Chemistry	3 credits
Biochemistry	4 credits
Chemistry Electives	3 credits
Breadth (Arts, Social Sciences, Math and Science, and Humanities)	37 credits
Environmental Measurement	3 credits
Application of Environmental Technology	3 credits
Seminar in Environmental Sciences	2 credits
Physical Education	2 credits
Subtotal	64 credits
Transferred	60 credits
TOTAL	124 credits

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American Public Health Association, American Society of Civil Engineers, American Water Works Association, Water Pollution Control Federation. *Glossary-Water and Sewage Control Engineering.* New York: the Association. Current Edition.

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American Public Health Association. *Standard Methods for the Examination of Water and Wastewater.* New York: the Association. Current Edition.

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